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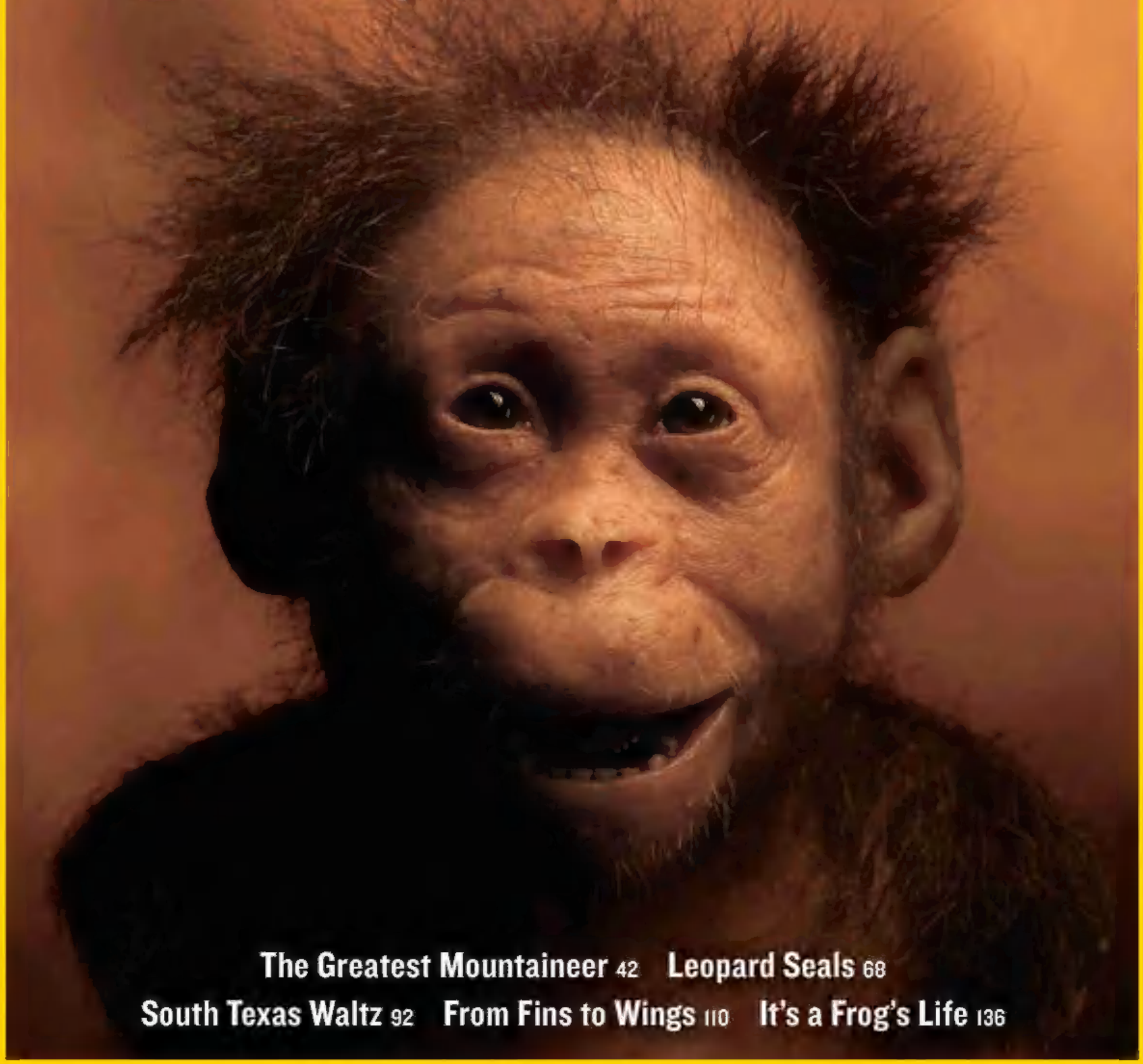
NATIONAL GEOGRAPHIC

FOUND Earliest Child

3.3-million-year-old bones discovered



They said no.

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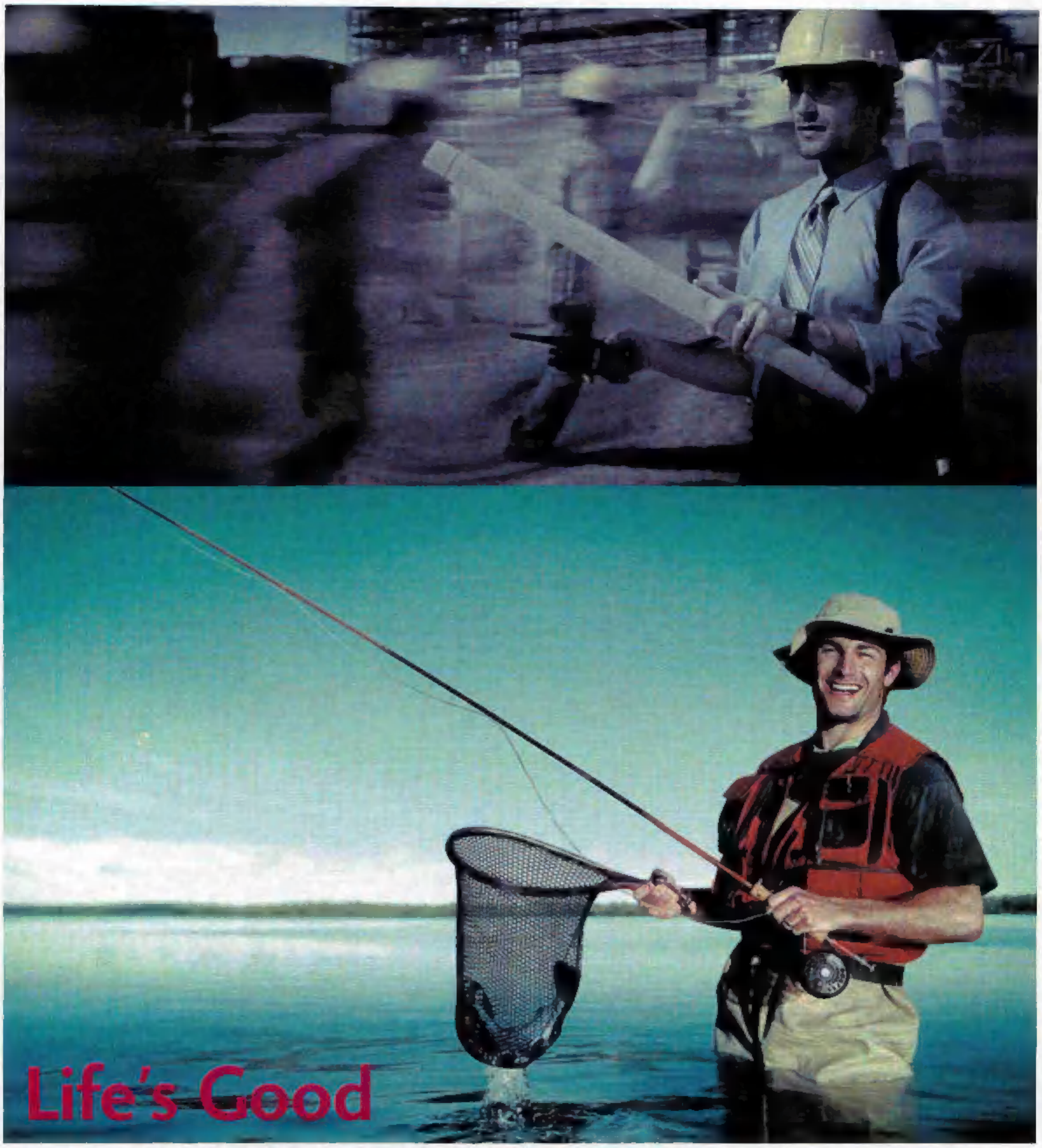

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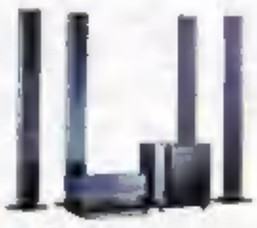

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NATIONAL GEOGRAPHIC

NOVEMBER 2006 • VOL. 210 • NO. 5

Deep in a Panamanian rain forest, a red-eyed tree frog may startle predators with its bright, bulging eyes, buying time to leap to safety. Story on page 136.

CHRISTIAN ZIEGLER

Features

COVER Ethiopia's ancient Dikika baby comes to life in this reconstruction.
PHOTO BY SARAH LEEN AND REBECCA HALE, BOTH NGS STAFF
ART BY KENNIS & KENNIS

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Miscellany

On the Web

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Live: WildCam Polar Bears
It's enough to make you shiver! Watch polar bears in the icy frontier of Manitoba's northeast coast at ngm.com/polarbearcam.

Origin of Childhood
Uncover the roots of the first human family. Travel back three million years using an interactive time line of evolution. Manipulate a 3-D model of the oldest fossil of a child ever discovered and join our forum on human origins.

Leopard Seals
Get in the water with photographer Paul Nicklen and Antarctic leopard seals. Find out about these fierce predators in a multimedia show. Then see more of Nicklen's photos in an online-exclusive gallery.

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PHOTOS: TINO SORIANO (LEFT); GERD LUDWIG (CENTER); GREG ROUSE (RIGHT)

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EDITOR'S NOTE

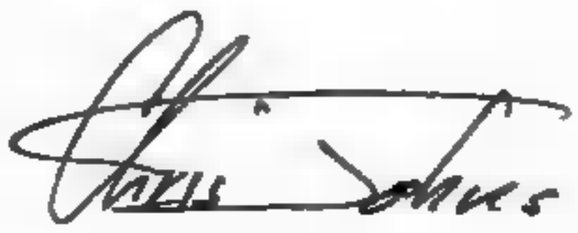
Climbing mountains has taught me more about photography than nearly anything else I've done, and this month's story on Reinhold Messner, the greatest mountaineer of all, reminds me why.

As a young man I climbed Oregon's Cascades. Later, as a photographer, I tackled peaks in Alaska, Canada, Tanzania, Kenya, and the Democratic Republic of the Congo. Every ascent gave me the joy of accomplishment. Each had something to teach. Digging out from an avalanche in Alaska's Chugach Mountains taught me lesson number one: how to "handle situations," as Messner

Reinhold Messner on the crest of Gasherbrum I in the Himalaya in 1984.

says. Learn to be calm in the face of chaos. Lesson number two: perseverance. "If you have to crawl on hands and knees, you're going to get there," said the late Barry Bishop, a GEOGRAPHIC staffer and a member of the first American expedition to summit Everest. The last lesson: observation. Pay attention to the weather, your gear, and every step you take.

Climbing mountains stretches you physically and mentally. You tap reserves you never knew you had. Doubt evaporates. You know who you are and what you can do. The secret of Reinhold Messner's ability to do the impossible—to conquer the highest mountains unaided by oxygen—was this: Messner, said Nena Holguín, his companion on his 1980 Everest climb, "trusted himself."



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LETTERS

July 2006 *It's not unusual for* GEOGRAPHIC *readers to comment on stories dealing with evolution, but "The Downside of Upright" may have grabbed people's attention for yet another reason: It dealt with ■ topic everyone can relate to—the human body. Many wrote letters offering advice on birthing, back pain, and exercise.*

Comment on November stories at **ngm.com**.

The Downside of Upright

Our spines are wondrously made! That we suffer from so much back injury is not so much a function of a deficient design but rather its abuse. We do not slip disks or develop scoliosis merely because we walk on two legs not four. It is how we use our spines that proves the greater risk. Lifting with your back and not your legs, hunching for hours over ■ computer keyboard, and lying back in comfy lounges all contribute to weak spines.

VINCENT P. BOWYER
Lismore, Australia

This article provides ■ blow to "intelligent design." No one would design a procedure that stressed the head and shoulders as much ■ humans have to go through in birth. Please tell Jennifer Ackerman that she has done ■ magnificent job of explaining what modifications were made as we adapted from our simian ancestors and stood on two feet.

DAVID C. MOORE
Gaithersburg, Maryland

The article tried to come to grips with the innumerable changes that *Homo sapiens* had to undergo to become bipedal. One would need great faith to believe that all these changes actually took place. Wouldn't it take less faith to believe that ■ divine being, a creator God, fashioned human beings to be bipedal from their very beginning?

PETER DICK
Steinbach, Manitoba

I am ■ registered nurse with 20 years experience in childbirth

education, labor support, and maternity nursing. Let me set the record straight. Birth is not the same as shoving a hard model skull through a hard model pelvis. The fetal skull and maternal pelvis are both flexible living tissues. Second, the shape of the pelvis is not a "marginal" design. It is a labor-saving device, based on the inclined plane principle. Next, a fetus does not have "broad, rigid shoulders." The unborn infant's shoulder girdle is flexible and compresses into a cylindrical shape during passage through the pelvis.

DENISE P. GROSE
Columbia City, Indiana

When women give birth in an upright position, instead of lying in a semi-reclined position, which pushes the tailbone closer to the pubic bone, the pelvic opening is normally ample. When unaffected by pain medication, the baby is normally adept at making the rotation in the birth canal without assistance. Although human birth may be more complicated than primate birth, it is not nearly as dangerous as the article implies. Unnecessary intervention in the natural birthing process, however, is.

DAWN WOODRING
Lake Ariel, Pennsylvania

I was distressed to see a show-biz chimp used for a photo shoot. These animals are usually pulled from their mothers and are never socialized as chimpanzees. When they become too large, strong, and unpredictable to be used by the entertainment industry, they are outcasts, and these social creatures almost always spend the remainder of their long lives in isolation.

KIMBERLEE RAYMOND
Chicago, Illinois

Photographer Cary Wolinsky replies: Everyone involved in this project, NATIONAL GEOGRAPHIC staff and researchers at Harvard University and University of

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LETTERS

California at Davis, shares these concerns about chimps. It took several years to find a chimp that met the researchers' strict criteria, which included a nonabusive personal history and good, social living conditions. I got to see these chimps in a caring environment before I began to work with them.

Land on the Edge

Your article did ■ tremendous job of highlighting not only the ecological and economic importance of our oceans, coasts, and Great Lakes, but also their declining health. Thank you for turning the tide on this crisis before it is too late. Members of the U.S. Commission on Ocean Policy and the Pew Oceans Commission have joined forces in a bipartisan effort, the Joint Ocean Commission Initiative, to help protect and enhance the long-term vitality of our oceans. The article's heroes are making a difference to improve the health of our coasts. However, concerted and sustained effort by all of us is needed, and change will only occur when citizens communicate their concerns to government officials and insist they support programs that protect our oceans.

LEON E. PANETTA
ADM. JAMES D. WATKINS
Co-chairs, Joint Ocean Commission Initiative, Washington, D.C.

Corrections, Clarifications

Land ■ the Edge (July 2006)
Figures for bacteria counts on page 66 were mistakenly stated in parts per billion. The correct measurement is organisms per 100 milliliters of water. The error was corrected on press in half our issues.

As a 27-year-old Florida Panhandle native, I was disappointed to see the St. Joe Company given a flattering portrayal in your article. For every tony coastal community that gets packaged as a refuge, hundreds of strip malls, gas stations, and big-box stores follow closely behind—all to serve the thousands of incoming, "nature-loving" transplants. Two-lane roads become four-lane highways. In fact it threatens not only the wildlife but also the unique, centuries-old culture of this state.

VIOLETTA SHEKINAH
Tallahassee, Florida

Panda, Inc.

Lynne Warren's insightful cost-benefit analysis of giant pandas in American zoos went deeper than those from other major media outlets. Warren's prose, along with the poignant photography, revealed the benefit of such investment—international scientific collaboration that can save species. Fujifilm's more than eight-million-dollar commitment to the Smithsonian's National Zoo helped us shoulder our cost—it also funds the Fujifilm Giant Panda Habitat, home to our beloved giant panda family. Success in saving giant pandas may be within our reach, but thousands of other species, including Asian elephants and Sumatran tigers, also live perilously close to extinction. Zoos can help save them, and corporate support makes it possible.

JOHN BERRY
Director, Smithsonian National Zoological Park
Washington, D.C.

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LETTERS

On the cute and cuddly scale, giant pandas certainly rate high, but I never thought I would see the amazing image on pages 50-51 of 16 perfectly behaved baby pandas posing for posterity. How wonderful that the efforts of dedicated researchers and caretakers are bringing the panda back from the brink of extinction.

DANIEL [redacted]
Berlin, Germany

Pandas are undeniably cute. I only wish that the other endangered animals in the world garnered half the attention. I couldn't help but think of the panda's cousins, the thousands of Asiatic black bears confined in China's notorious "bear farms" to harvest their bile for medicinal purposes. These creatures are constrained indoors for life in holding devices barely larger than their bodies. They are implanted with permanent catheters, which usually cause infections, to drain their gallbladders for their prized bile.

ERIC MILLS
Action for Animals
Oakland, California

Dance Across America

I want to thank Cathy Newman for a very informative and inspired article. As the director of a small dance school in New Jersey, I find it difficult to approach young parents about the benefits of educating their children in all kinds of dance. The simple fact that dance precedes the spoken language seems to escape our view as young parents. My dance students age six to teens are not aware of dance icons like Fred Astaire and Ginger Rogers, but in Romania, I grew up with their dancing. How can we keep their legacy alive in the U.S. if we don't expose our children to dance?

VIORICA STAMPFEL
Ocean, New Jersey

From our online forum
ngm.com/0607

If "Shall We Dance?" and "The Downside of Upright" had not been placed consecutively, I might not have appreciated the contrast between them. As it is, I cannot pass up the irony. Jennifer Ackerman's article states that, in reference to scoliosis and other related disorders, "No

other primate experiences such back problems." She suggests that because of our ability to stand erect, we have acquired a host of problems that chimps never encounter. But because of our posture and perhaps something more, humans are capable of movements a chimp could never perform. We can dance the fox-trot, the tango, and the waltz. And, as Cathy Newman wrote, "To dance is human. To dance is divine." Perhaps our ability—and desire—to dance is an expression of that soul within us that no animal can lay claim to.

[redacted]
Russiaville, Indiana

Voices: Peter Benchley

What a beautiful and moving piece! While I know of Mr. Benchley through his writing in the GEOGRAPHIC and other places, and of course *Jaws,* I feel I have a more complete understanding of this talented and passionate man. I can only hope someone loves me enough to offer such an intimate and touching tribute as did Mr. Doubilet for Mr. Benchley.

ED CONNOR
West Springfield, Massachusetts

The remembrance of Peter Benchley by David Doubilet was wonderful. I have a better appreciation for both men and their work. We must save the sharks and other creatures that live in the ocean.

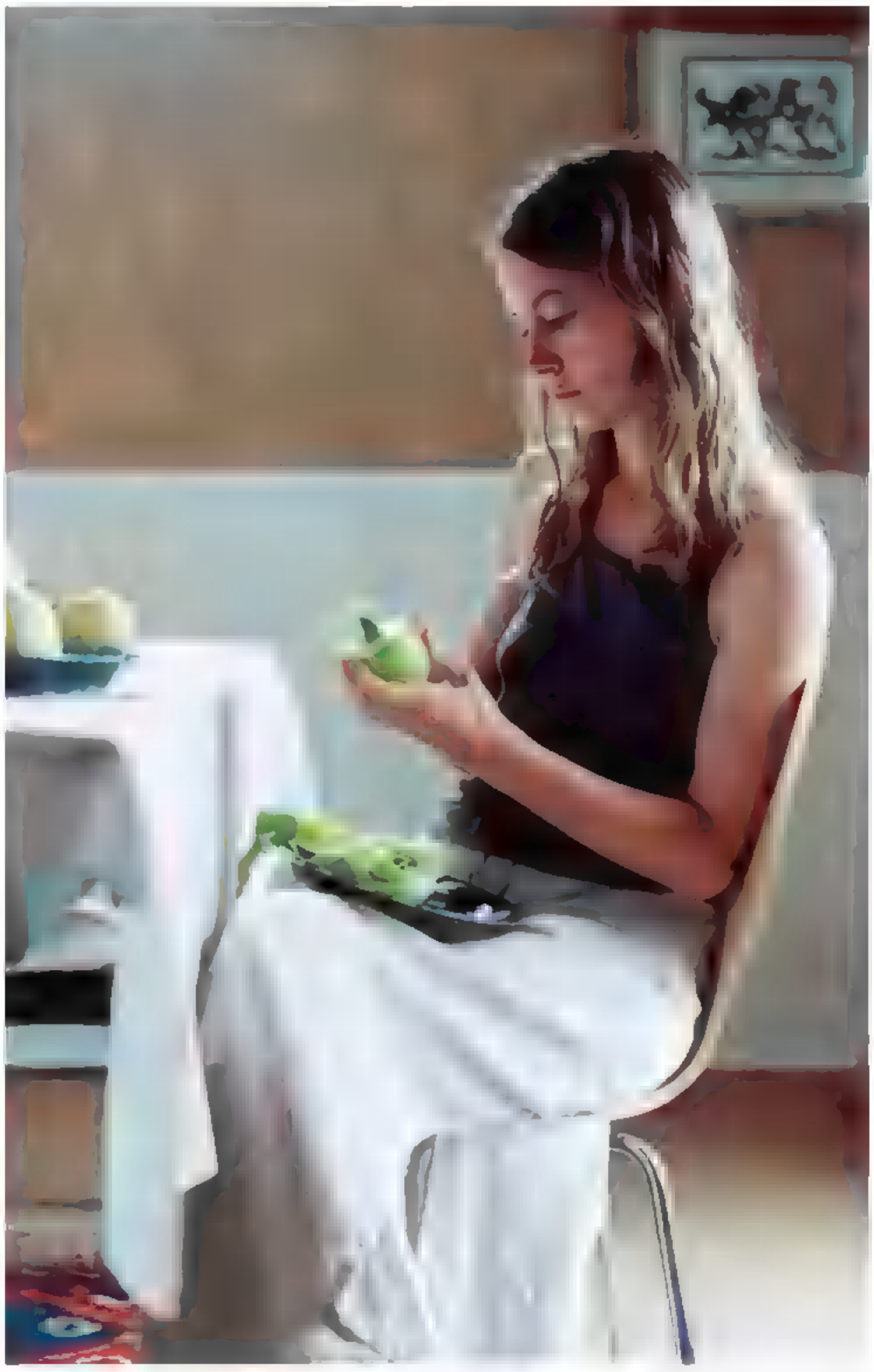
NEVA SIMONTON
Katy, Texas

Vanishing Hedgehogs

In spite of the diminishing stock of hedgehogs in England reported by Siobhan Roth, there is a surplus in parts of Scotland. Hedgehogs will eat anything on the ground, including eggs, and since they were introduced to islands off the coast of Scotland, no doubt to control the slugs in gardens, the numbers have increased substantially. Now they threaten the ground-nesting birds for which the islands are famous. The trouble is so great that a scheme for catching the hedgehogs and shipping them to the mainland has been introduced. Not surprisingly, the measure has met with some resistance.

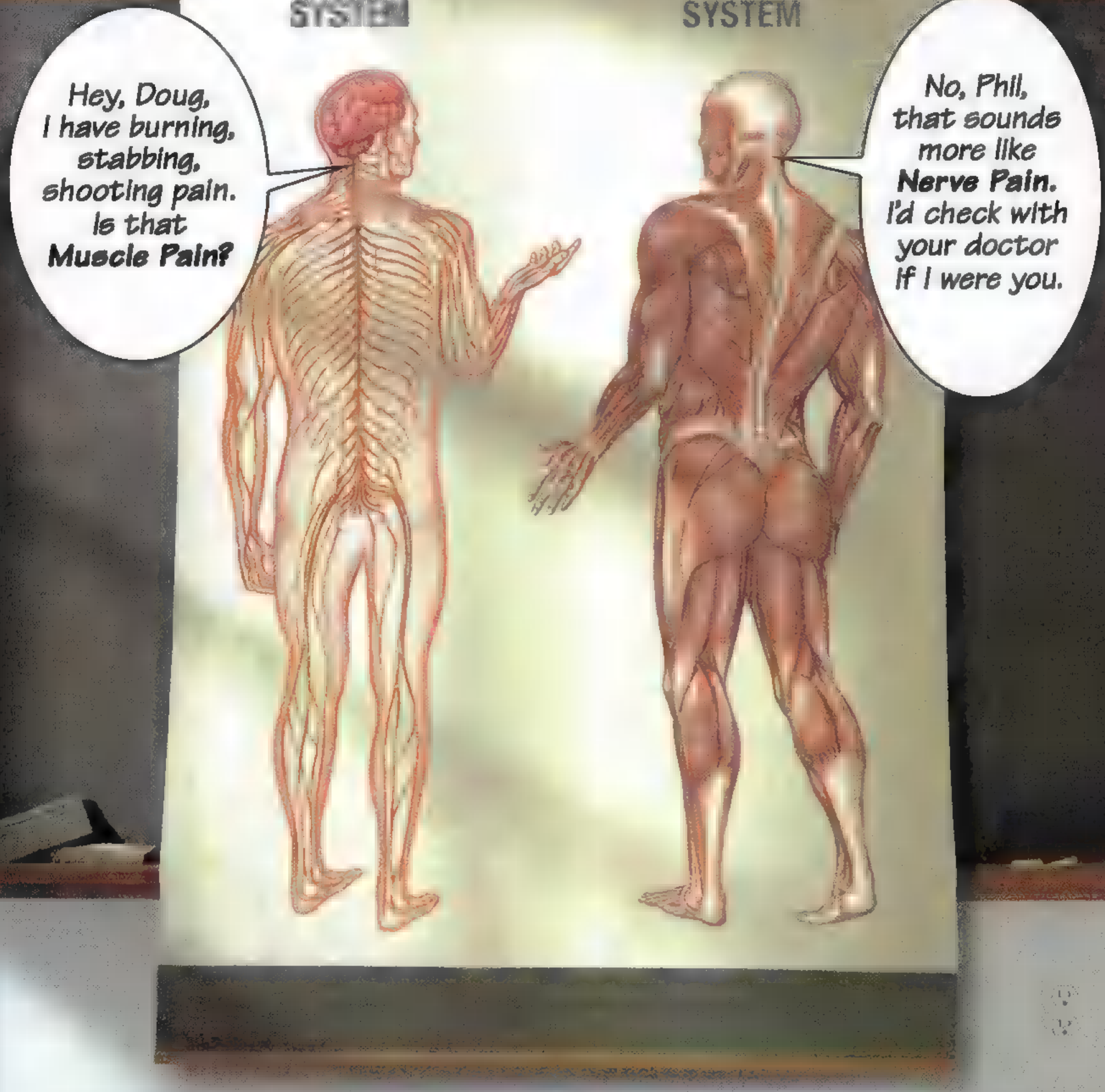
TOM CARTER
Aberdeen, Scotland

Send Us Something Wonderful This picture was selected by our editors from reader photographs posted to the Your Shot website on the theme of "Around the Table." Submit a favorite photo of your own—this month, on any topic of your choosing—for possible publication in an upcoming issue of NATIONAL GEOGRAPHIC. For guidelines, a submission form, and more information, go to *ngm.com/yourshot.*



Hrvoje Glavota
Greenwich, New York

There is no written recipe for the family's apple strudel. So Hrvoje Glavota's wife, Sarah Begley, asked her visiting mother-in-law to teach her how to prepare the pastry. "She and my mother made the dough the night before," says Glavota, a 37-year-old geotechnical engineer. "The next morning, I saw Sarah sitting there in the light peeling apples, and I just thought she looked so perfect."



Doug is right. If you have burning, stabbing, numbness, and tingling sensations, it could be nerve pain. Nerve pain is different from the aching, tenderness, and stiffness of muscle or joint pain — also known as musculoskeletal pain. If you experience the symptoms of nerve pain, talk to your doctor to see if there is anything that can help. Or visit nervepaininformation.com for more information.

nervepaininformation.com

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Dusted with spores from others in the cluster, *Coprinellus disseminatus* mushrooms shelter an ant.

The first GEOGRAPHIC article by writer, photographer, and biologist Mark W. Moffett, "Marauders of the Jungle Floor," was published in August 1986.

Gorgeous Fungus Nature photography often features gaudy species that make an easy impression. The challenge is to get people to fall in love with the quiet and the unexpected—such as the beautiful lines of a simple white mushroom. At the Tiputini Biodiversity Station in Ecuador, I took more than a hundred images of fungi that exploded from the landscape during the downpours that consumed the first three days of my visit.

As ■ canopy biologist, I think a lot about the architecture of trees, their leaves and branching patterns. Mushrooms intrigue me in the same way. They are the reproductive organs of larger fungal growths underground, mostly hidden from view: hair-thin hyphae that spread into ■ microscopic latticework to infiltrate and feed on soil, plant and animal matter, and even rock. The overall weight of some of these latticeworks exceeds that of a blue whale; a few may even be older than the oldest bristlecone pines.

Rising from the hyphal mats by means of fluid pressure in their tissues, mushrooms are fleeting. Many appear, expand, and die in just days. Microscopic spores develop on gills beneath the caps, protected from rain. The gills fling the spores into the air currents below, which divert them away from the caps, like wind beneath an airplane wing. Severed from their parents, the spores can establish far-flung colonies—and start all over again.

Mantids See more photos by Mark Moffett at **ngm.com/0601/feature7**.

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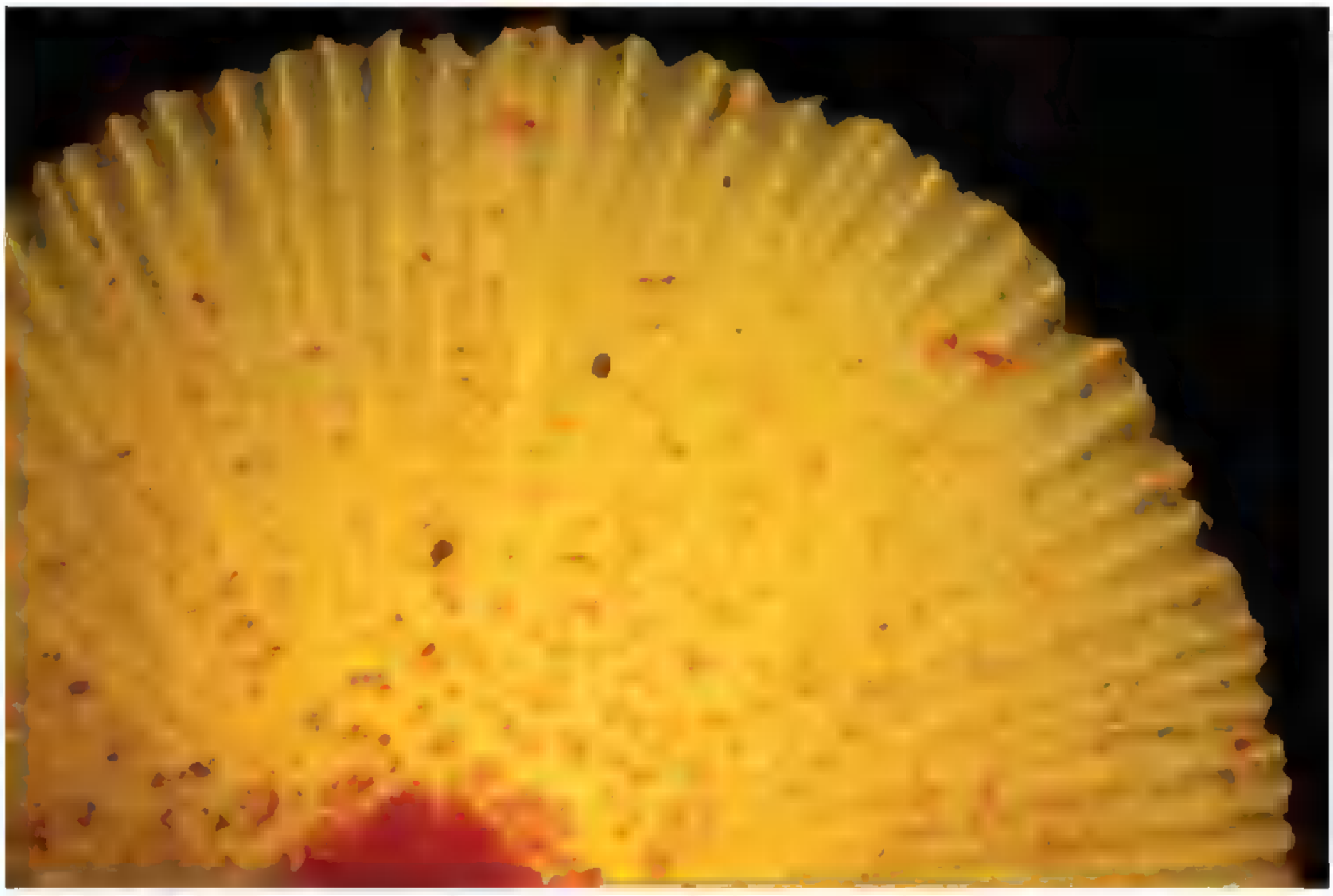
A species of *Marasmius* (above)—one of nearly 200 of this genus reported in South America—is ideally suited to life on the forest floor. Drying out during the day ■■ the leaf litter loses moisture, it revives with nighttime condensation or the sprinkling of rain. *Leucocoprinus birnbaumii* (below), toxic if ingested, is widespread in the tropics.



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This unidentified fungus growing on a stick is "either a species of *Hemimycena* or *Mycena,*" says expert Dennis Desjardin, professor of mycology at San Francisco State University. The pale coloration and lacy gills are similar in both genera.

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Tiny *Marasmius leucorotalis* (above) seem to float atop threadlike stems. These mushrooms play an important part in the decomposition of the forest floor; their generic name means "to wither." Bristling clusters of cup fungi (below) are young *Cookeina tricholoma*. When mature, spores are shot from the cups by microscopic cannon called asci.

Gee's Golden Langur *(Trachypithecus geei)*
Size: Head and body length, 49 - 72 cm; tail, 71 - 94 cm **Weight:** 9.5 - 12 kg
Habitat: Lowland, evergreen, semi-evergreen, riverine moist deciduous, sal-dominated moist deciduous and degraded forests **Surviving number:** Estimated at 4,500 - 5,000

Photographed by Elio della Ferrera

WILDLIFE AS CANON SEES IT

There's gold in these trees. Gee's golden langur sports a rich pelage that flashes like gold in the sunlight. This gold appears for only part of the year, however; in the summer, its color changes to cream. The little monkey spends nearly all its time in the trees, living peacefully in small troops and foraging for tasty leaves, seeds, fruits and flowers. But drastic deforestation has forced it to range more widely in search of sustenance, a perilous practice when it comes to cultivated areas where it is perceived as a threat to harvests. As a result, this particular kind of gold is becoming increasingly rare with each passing day.

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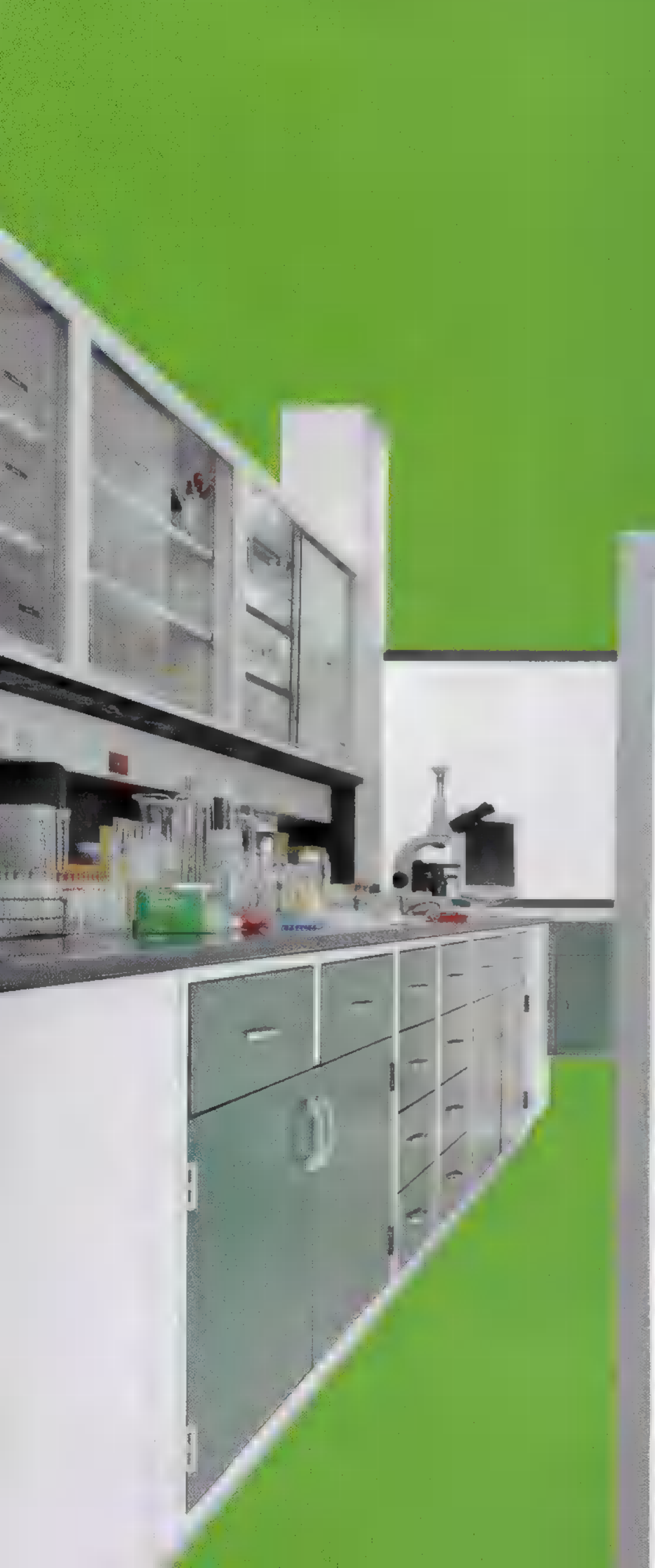

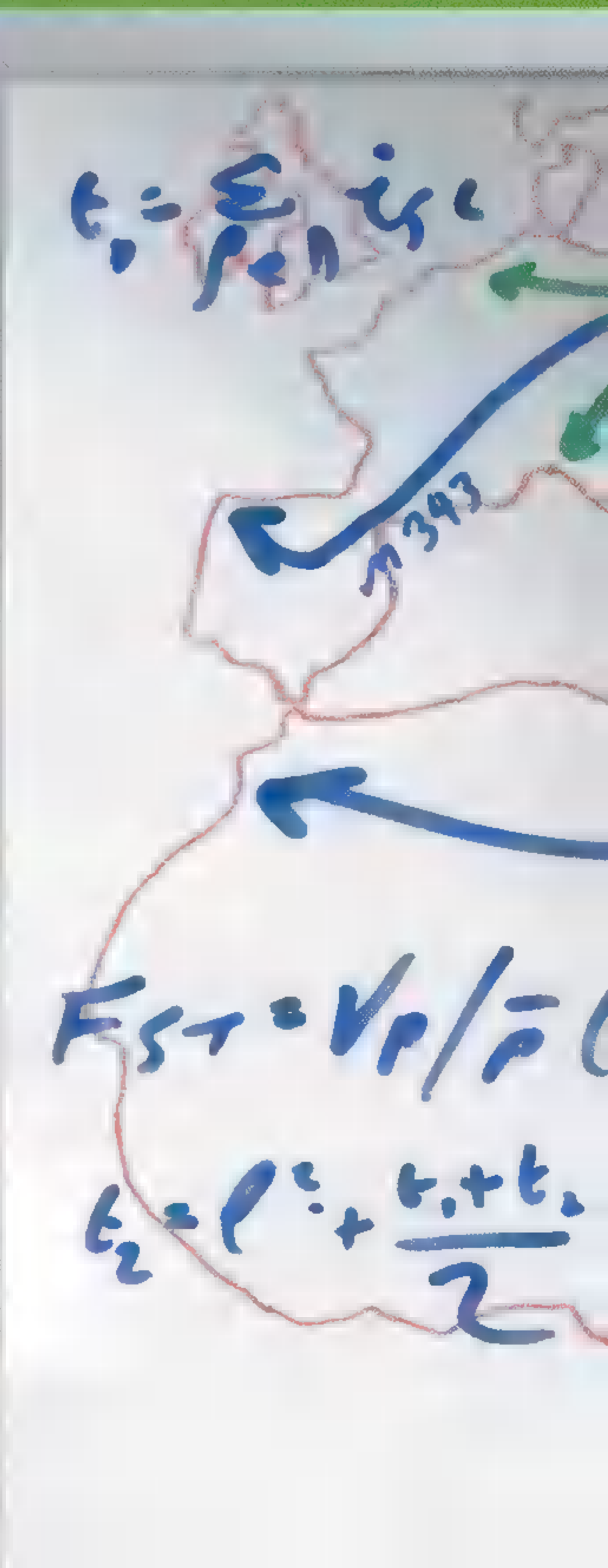
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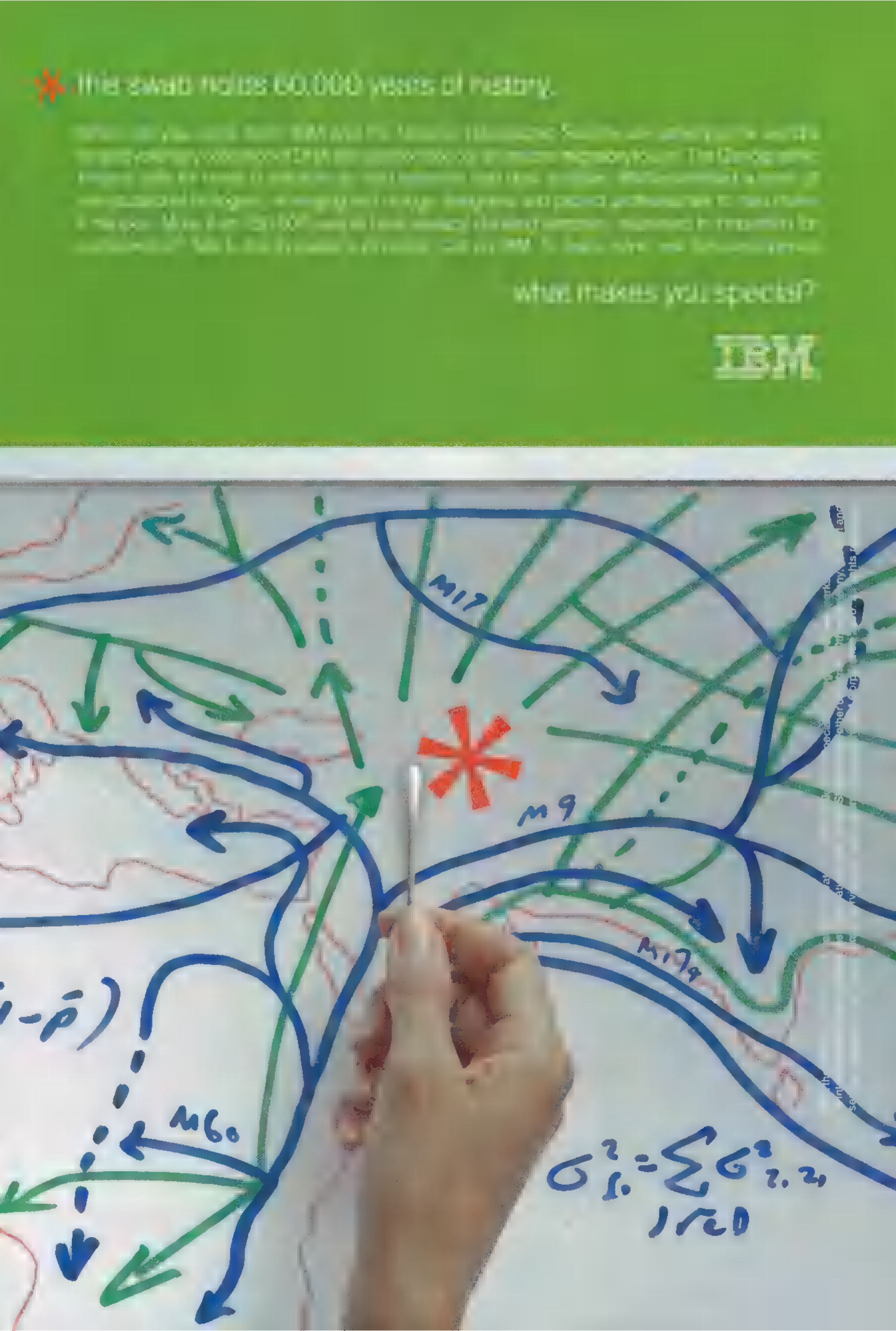
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VISIONS OF EARTH

Namib-Naukluft Park, Namibia Late afternoon sun silhouettes dead acacia trees against a backdrop of sand dunes. In this park on southern Africa's west coast, the dunes rise as high as a thousand feet from the desert floor.

PHOTO: STEFANO UNTERTHINER

Ningaloo Marine Park, Western Australia A banded toadfish hides among the coral on 185-mile-long Ningaloo Reef. Branching skin growths help camouflage the foot-long fish from both predator and prey.

PHOTO: TAKAKO UNO

Catalonia, Spain Young people in oversize papier-mâché heads pause in a blooming field on the way to a summer festival in the town of Banyoles. Called *capgrossos* in Catalan, the big heads are often worn on feast days.

Decorate Your Desktop with Visions of Earth images in Fun Stuff at **ngm.com/0611.**

PHOTO: TINO SORIANO

A leafy seadragon drifts near shore along South Australia's Fleurieu Peninsula, where fields of kelp offer safe haven.

NG GRANTEE **Seadragon Survey** Is it seaweed or modern art? Neither: This cousin of the seahorse is the leafy seadragon, ■ fish seen only off Western and South Australia. Scientists know little about it, so marine biologist Greg Rouse has been collecting its DNA. He's discovered that what he thought were two species are likely just one inhabiting a broad range. Well over ■ foot long, seadragons grow bony prongs from the spine, ribs, and head that trail gauze-thin ribbons of sublime camouflage. "You can point one out to someone, and they won't see it," says Rouse. "I'm sure I swim over them all the time." *—Michael Klesius*

Field Notes

Reports of two new killer whale species in Antarctica have been floating around for decades. Biologist and NG grantee Robert Pitman is trying to find out for sure. One of the possible new orca species certainly looks different from the black-and-white *Orcinus orca* of Shamu fame. It's six to nine feet shorter, and its markings are gray, black, and dingy yellow. The other new whale also has these tricolor markings but is slightly larger and has an appetite for seals instead of fish. Earlier this year, Pitman tagged ten of the fish-eating whales and took DNA samples. He hopes to expand the program next year. "My guess is there's at least one new species down there, maybe two," he says. "We still need to find out what they do and where they go."

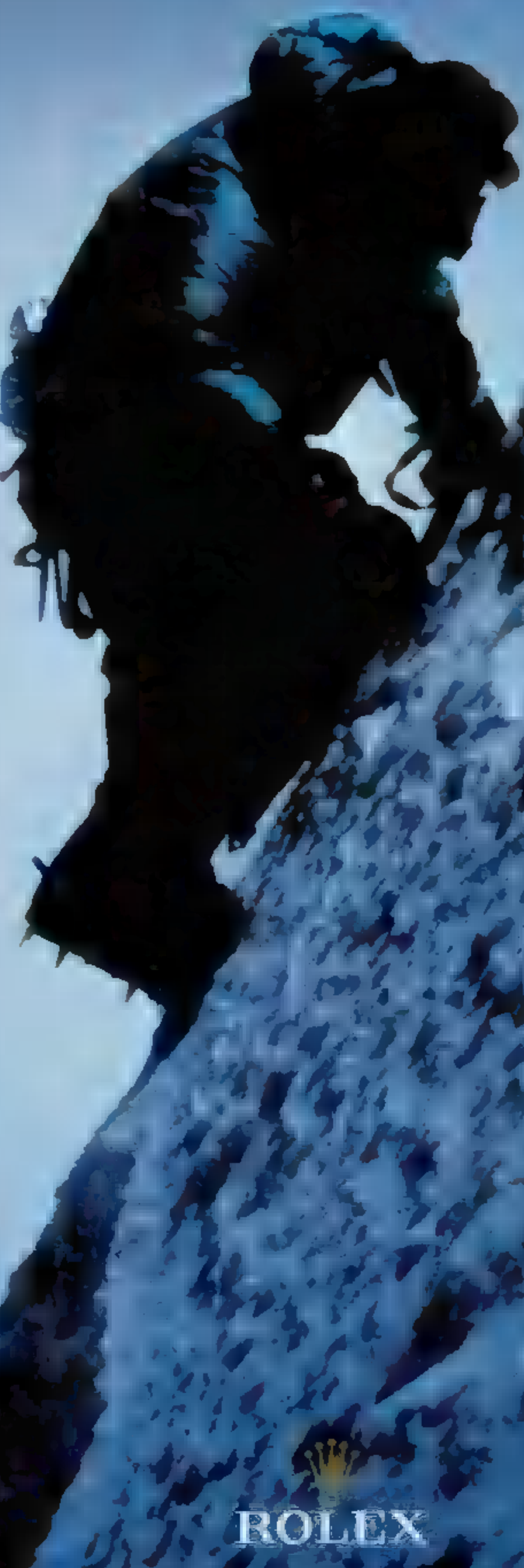
PHOTO: GREG ROUSE

WELCOME

TO THE

TOP OF THE

WORLD



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MAKALU SUMMIT:
27,765 feet / 8,463 meters

The Himalayas are home to all 14 of the world's tallest mountain peaks. Looking toward the East, from the top of Everest, Makalu's massive pyramid-shape rises up unmistakably as one of the most impressive to view.

May 12, 2005. Ed Viesturs reached the summit of Annapurna, making him the first American to climb all 14 mountains above 26,246 feet / 8,000 meters; a feat he achieved without supplemental oxygen.

An innovator in modern alpinism, Jean Troillet climbs with light packs and minimal equipment, enabling him to be one of the fastest climbers on Earth. In 1986, he set the record for the fastest ascent of Everest by the North Face route. He made it there and back in 43 hours.

In 1975, after surviving an avalanche, Junko Tabei of Japan took the South-East Ridge route, becoming the first woman to reach the summit of Everest. She continues to be an inspiration today.

May 29, 1953. Sir Edmund Hillary and Tenzing Norgay were the first to summit Everest. Expedition leader Sir John Hunt said: "We have indeed come to look upon Rolex Oysters as an important part of high climbing equipment." Later that year, Rolex officially launched that watch as the Rolex Explorer.

"On the mountain [Everest] where, owing to the insidious effects of altitude, one is inclined to forget small routine tasks, the self-winding mechanism proved to be a wonderful asset." – W.B. Beaven, 1954 New Zealand Himalayan Expedition.

Starting in 1933, Rolex regularly supplied watches to mountaineering expeditions. That year, a British expedition, led by Hugh Ruttledge, had the summit of Everest clearly in sight. They reached an altitude of 28,150 feet / 8,580 meters, but it would be another 20 years before Sir Edmund Hillary reached it.

Tibetans call Everest "Chomolungma," Mother Goddess of the Universe. In Nepal, it's called "Sagarmatha," Goddess of the Sky.

1933. In the Houston Everest Flight Expedition, Stewart Blacker and his team proved aerial photography was the best way to map Everest. They pushed their small propeller plane to altitudes in excess of 26,246 feet / 8,000 meters, where the temperature was estimated to have dropped from a blistering 180°F to -41°F / 82°C to -41°C in a matter of minutes. Their Rolex Oysters performed flawlessly.

Above 26,000 feet / 7,925 meters, jet stream winds can gust to more than 118 mph / 190 km/h, making it impossible to even attempt to reach the summit.

Rising 29,029 feet / 8,848 meters above sea level at the border of Tibet and Nepal, Mount Everest lays claim to the highest elevation on Earth.

MAKALU, AS VIEWED FROM THE SOUTH-EAST RIDGE OF EVEREST.

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Figures of Faith

Age and position

28, priest in Moscow Diocese

The path

Following ordination in a Moscow seminary eight years ago, he was approved by a bishop and appointed to his parish.

Grooming

Orthodox priests wear their hair and beards untrimmed to discourage vanity and to evoke Christ's likeness.

Clothing

The red vestments are worn during Easter season. The hat denotes high standing in the priesthood.

Community

A few hundred parishioners, half the town, fill the church beyond capacity each week.

FATHER DIMITRY MURZUKOV
Russian Orthodox Church
Reutov, Russia

Age and position

17, novice monk

The path

At 16, he gained entrance to Sera by memorizing 300 scripture pages and passing an oral exam.

Grooming

Monks shave their heads and faces to discourage vanity and to live as simply as possible.

Clothing

Monks follow the Buddha, who traded his clothing for simple robes 2,500 years ago.

Community

800 monks live in the monastery, which nearly 2,000 devotees visit weekly.

NAWANG TENZIN
Gelukpa sect of Tibetan Buddhism
Sera Monastery, Tibet

PHOTOS: GERD LUDWIG (LEFT); JASON SANGSTER

The statue of Queen Tiye dates from between 1391 and 1352 B.C. It's now on display at Cairo's Egyptian Museum.

Long Lost Queen She was found lying facedown in a pile of rubble, but her hairstyle and headdress marked her as royalty. Discovered by archaeologist Betsy Bryan and her team at ■ temple site in Luxor, Egypt, the black stone figure—just over five feet tall—turned out to be the only known life-size statue of Queen Tiye by herself (above).

More than 3,300 years ago, Tiye was the region's most powerful woman: first wife of the pharaoh Amenhotep III; mother of Akhenaten; and possibly the grandmother of the boy king, Tutankhamun. Bryan speculates that Tiye may even have ruled briefly following her husband's death. *—Cate Lineberry*

Fresh Dirt

Figs were first cultivated between 11,400 and 11,200 years ago, according to ■ paper published in *Science*. In an early Neolithic village site in Israel, nine carbonized figs were found with ■ store of grains and acorns. The figs came from a variety of tree that cannot reproduce through pollination but is propagated only by cutting and planting branches. The find pushes the earliest known fruit cultivation back by about 5,000 years.

Carved from stone, ivory, or wood, ancient Egyptian pillows seen in museums supported heads of the rich and royal. Regular folk slept on grass-filled pillows that accompanied their owners to the grave. Analysis of ■ grass pillow found in a Nile Valley cemetery reveals clues about the woman who used it some four thousand years ago. The grasses were local, but the mineral wax binding the fibers has no known Egyptian source. Researchers who studied the wax's composition point to Ein-Humar, east of the Dead Sea, as ■ potential source of the wax and possibly the original home of the woman's family.

PHOTO: JAMES T. VANRENSSELAER, JOHNS HOPKINS UNIVERSITY

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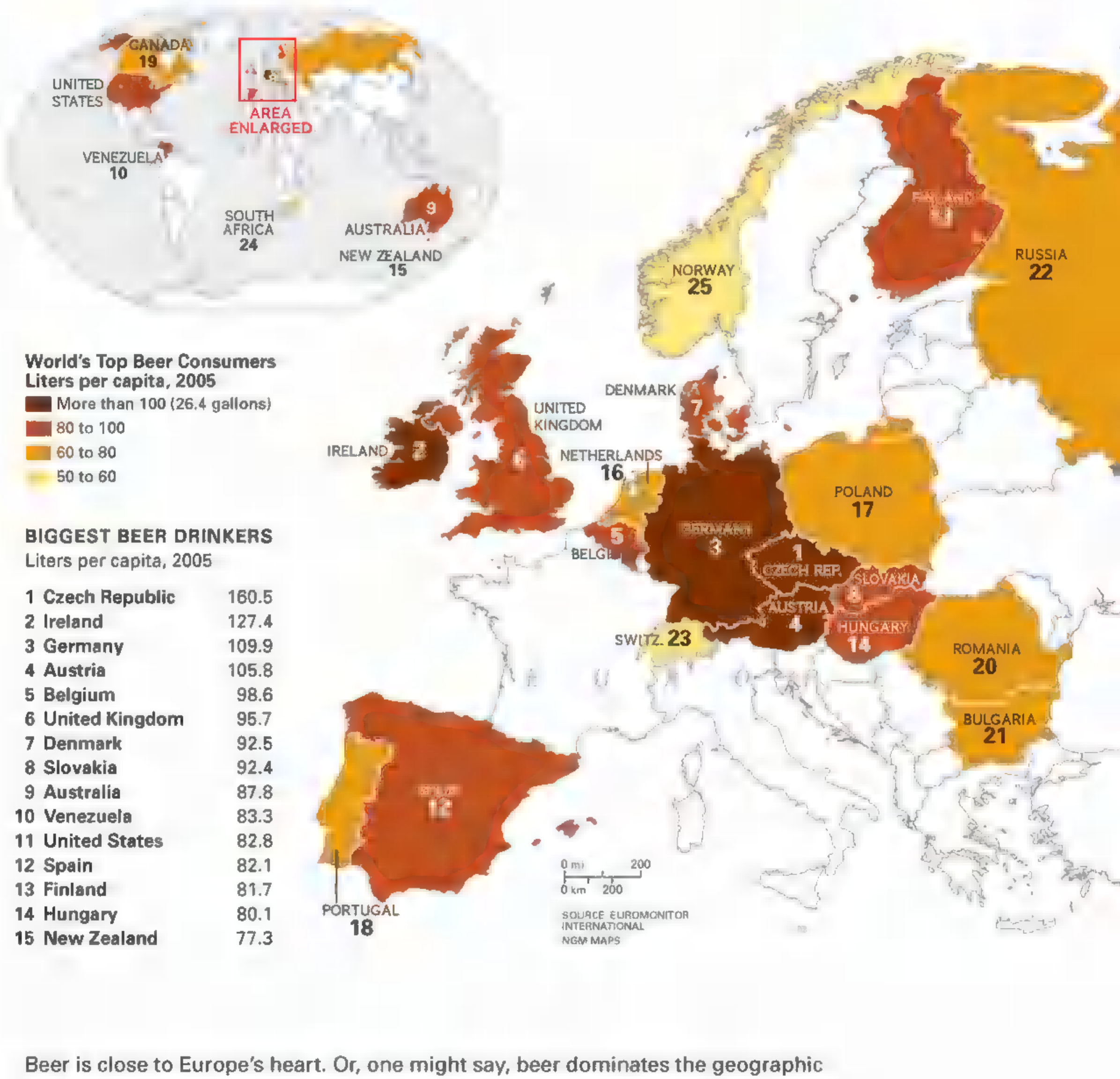
Beer Country



World's Top Beer Consumers
Liters per capita, 2005

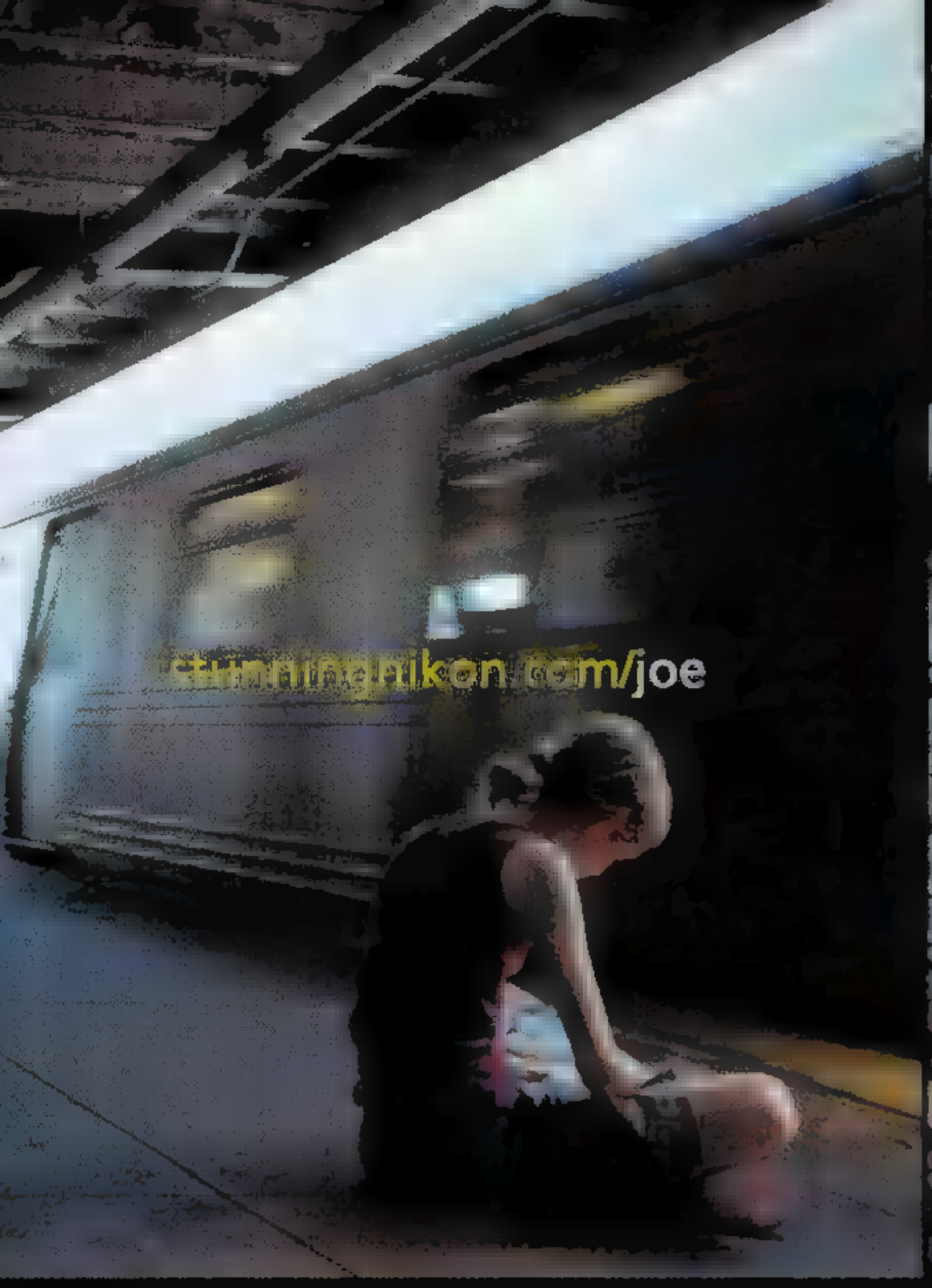
- More than 100 (26.4 gallons)
- 80 to 100
- 60 to 80
- 50 to 60

BIGGEST BEER DRINKERS
Liters per capita, 2005

1	Czech Republic	160.5
2	Ireland	127.4
3	Germany	109.9
4	Austria	105.8
5	Belgium	98.6
6	United Kingdom	95.7
7	Denmark	92.5
8	Slovakia	92.4
9	Australia	87.8
10	Venezuela	83.3
11	United States	82.8
12	Spain	82.1
13	Finland	81.7
14	Hungary	80.1
15	New Zealand	77.3

Beer is close to Europe's heart. Or, one might say, beer dominates the geographic heart of Europe. A line drawn northwest from central Europe bisects the great beer brewing and quaffing countries, the "beer belt" of the Czech Republic, Germany, Belgium, the United Kingdom, and Ireland. Austrians still have an imperial thirst, but their beer culture is much diminished since the days of empire.

Historically, what people drank generally depended on what they grew, says beer expert Michael Jackson. "If your climate is temperate but warm, you grow fruits and make wine. If it's temperate but colder, you grow grain and make beer. If the weather is colder still, you grow grain but tend to make distilled spirits." The beer belt is expanding. Beer sales in vodka-loving eastern Europe and former Soviet republics have been growing steadily. *—Chris Carroll*



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Nikon

At the heart of the image.

A healthy Tasmanian devil shows its teeth.

Devils in Danger Some 150,000 Tasmanian devils roamed Tasmania's coasts and woodlands in the late 1990s. A contagious cancer has since killed about half their number. The disease quickly deforms the mouth, face, and neck of its victim—and it's fatal. Its origin remains a mystery, but studies indicate that devils infect each other, passing cancer cells during rough throes of brawls and mating. Short of a cure, scientists are trying to control the disease by removing sick devils in some areas and quarantining healthy animals in case the wild population dies out. Despite the bleak outlook, devils are resilient: By the early 1900s, they'd been nearly hunted to extinction, but bounced back. With help, they may survive this latest threat. *—Neil Shea*

PHOTO: IAN WALDIE, GETTY IMAGES

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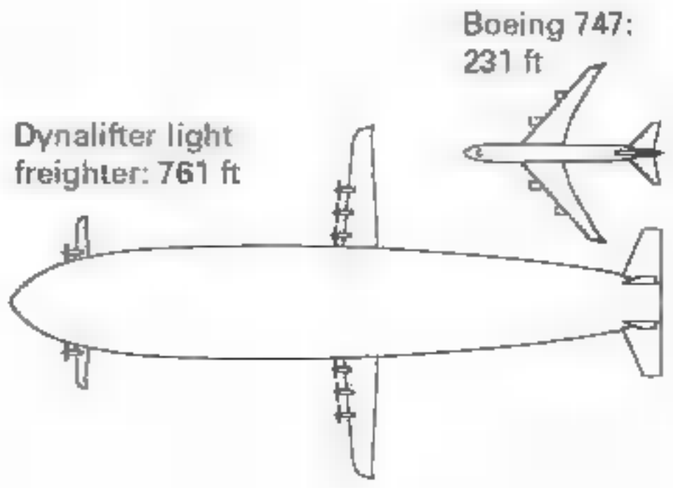
Don't Call It a Blimp Airships nearly vanished from the skies after the hydrogen-filled *Hindenburg* exploded over New Jersey in 1937. Today, companies from China to Germany are designing fuel-efficient hybrid craft that combine the helium lift of blimps with design elements from other aircraft. The Dynalifter, created by Ohio Airships' Bob Rist and Brian Martin, is the world's first working prototype. Measuring 120 feet from nose to tail, it's a test version of their much larger craft (above) that's designed to haul three times as much cargo as a Boeing 747, fly for ■ fraction of the cost, and, at speeds of about 130 miles an hour, beat an ocean freighter to port.

Airships could transform the aviation industry, says Barry Prentice, former director of the University of Manitoba's Transport Institute. "Demand is there," he says. Supply is sure to follow: Boeing, CargoLifter, and others have airship plans in the works. Meanwhile, Rist says that testing on the Dynalifter will continue for at least a year, and the company still needs financial backers to help them take off. But Rist is optimistic. "Our fellow Ohioans, the Wright brothers, started with far fewer resources." *—Carol Kaufmann*



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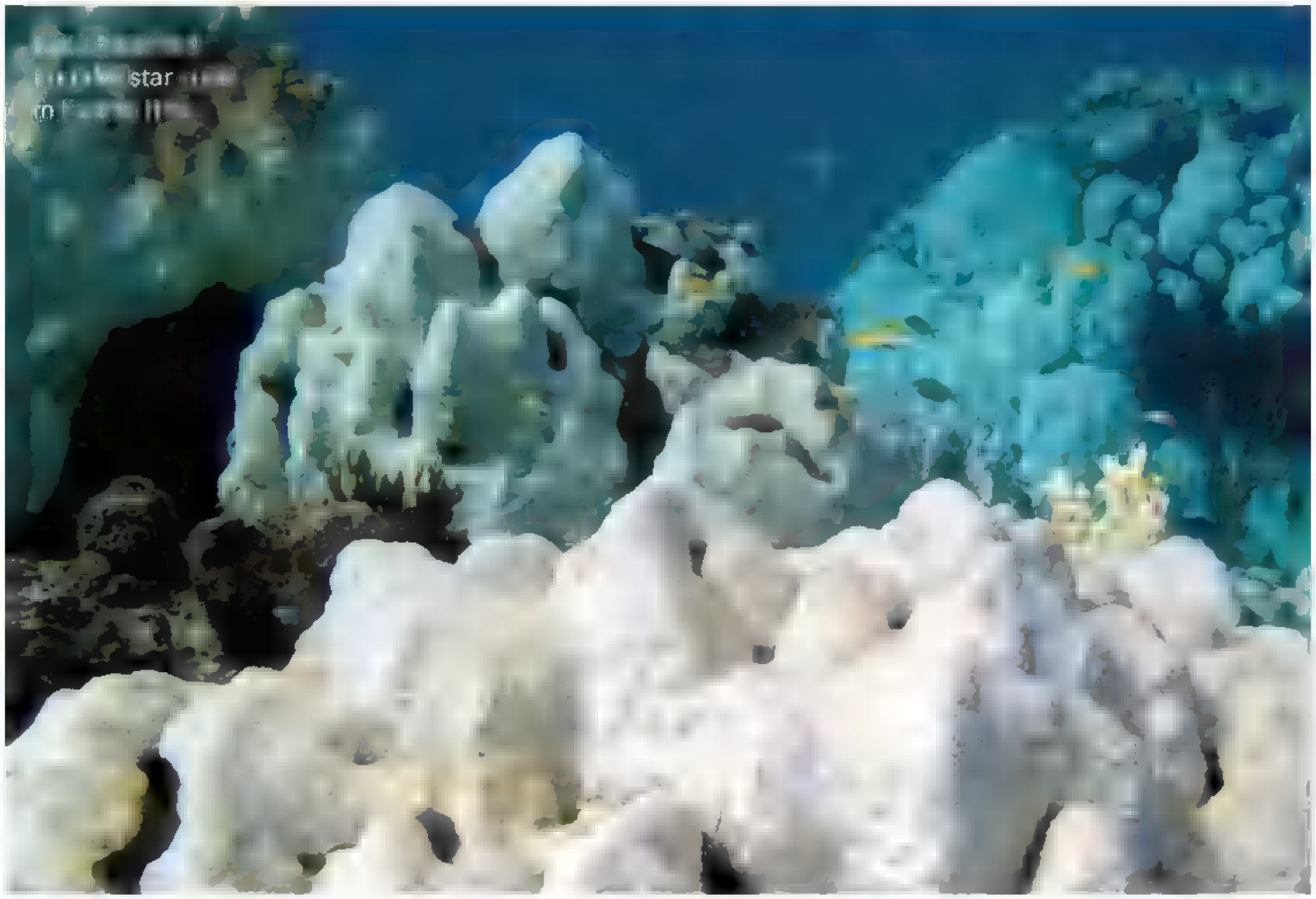
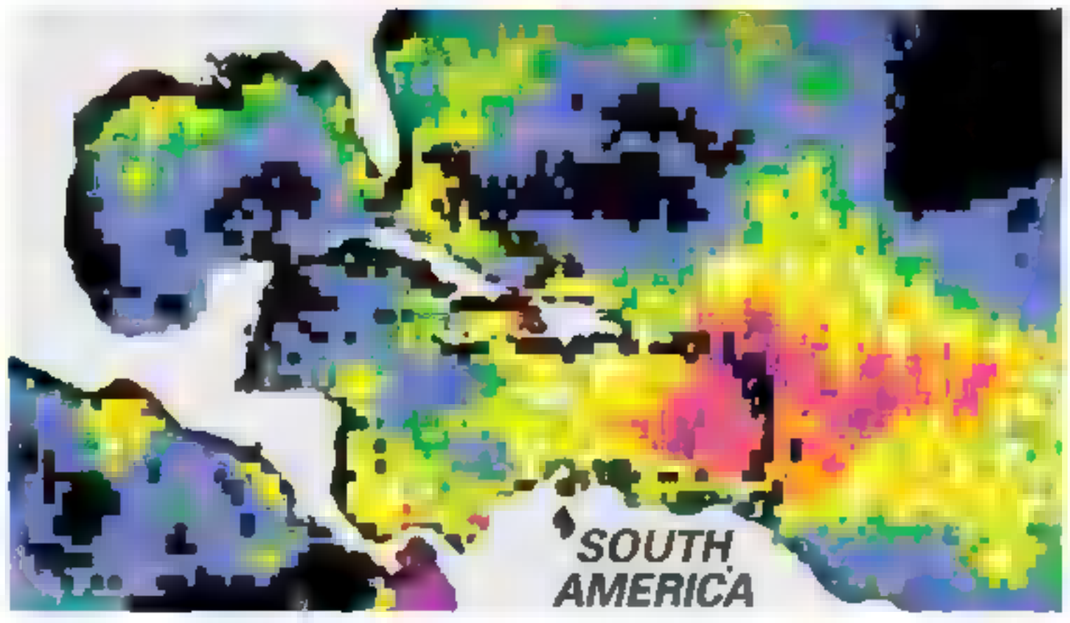


Caribbean Coral in Hot Water The summer of 2005 saw the worst bleaching ever of Caribbean coral, and scientists are braced for the 2006 results. The bleaching occurs when prolonged exposure to elevated sea temperatures causes coral to expel the colorful algae that supply it with sugars and oxygen in return for shelter and carbon dioxide. It represents "unequivocal evidence of global warming," says marine biologist Edwin Hernandez. At Culebra Island, Puerto Rico, for example, up to 97 percent of species surveyed, including boulder star coral (above), bleached when water temperatures rose to 31.8°C (89°F). Hernandez estimates that as much as half of Culebra's coral had died off by early 2006. Not only did the bleaching exceed any seen in two decades of satellite data from the Caribbean, but records show that water temperatures were the warmest in ■ century. "Catastrophic events such as this one may become more frequent," says Hernandez.



Satellite data show in pink where elevated water temperatures during mid-summer through early fall of 2005 in the Caribbean and Atlantic created stress on coral.

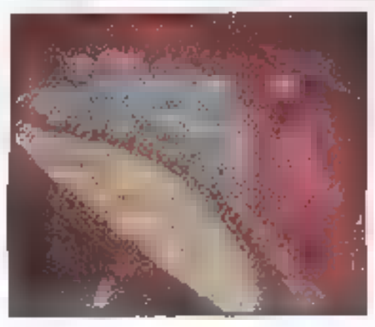
A recent study found that in the absence of algae, some coral species in Hawaii gorge on passing plankton. But the United Nations Environment Programme reports that 30 percent of the world's coral is dead, and predicts that more than half the remaining reefs will vanish by 2030. *—Michael Klesius*

PHOTO: PHOTOGRAPHER NAMEHERE

Clots are the number one cause of heart attack and stroke, but you can help reduce your risk.

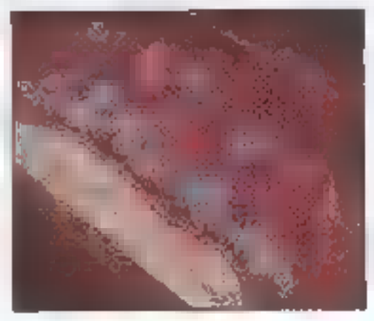
This is important information if you've been hospitalized with heart-related chest pain or a certain type of heart attack.

That's because these conditions, known as Acute Coronary Syndrome–or ACS–are usually caused when blood platelets stick together and form clots that block blood flow to your heart. And if you've already had a clot, you're at an increased risk for a future heart attack or stroke.



PLAVIX, in combination with aspirin, helps provide greater protection against a future heart attack or stroke than aspirin alone.

PLAVIX, taken with aspirin, plays its own role in helping reduce your risk of heart attack and stroke. That's because, unlike your cholesterol and blood pressure medications, prescription PLAVIX works to help keep blood platelets from sticking together and forming clots.



IMPORTANT INFORMATION: If you have a stomach ulcer or other condition that causes bleeding, you shouldn't use PLAVIX. When taking PLAVIX alone or with some medicines including aspirin, the risk of bleeding may increase. To minimize this risk, talk to your doctor before taking aspirin or other medicines with PLAVIX. Additional rare but serious side effects could occur.

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INDICATIONS AND USAGE

PLAVIX (clopidogrel bisulfate) is indicated for the reduction of atherothrombotic events as follows:

- **Recent MI, Recent Stroke or Established Peripheral Arterial Disease**
  For patients with a history of recent myocardial infarction (MI), recent stroke, or established peripheral arterial disease, PLAVIX has been shown to reduce the rate of a combined endpoint of new ischemic stroke (fatal or not), new MI (fatal or not), and other vascular death.
- **Acute Coronary Syndrome**
  For patients with acute coronary syndrome (unstable angina/non-Q-wave MI) including patients who are to be managed medically and those who are to be managed with percutaneous coronary intervention (with or without stent) or CABG, PLAVIX has been shown to decrease the rate of a combined endpoint of cardiovascular death, MI, or stroke as well as the rate of a combined endpoint of cardiovascular death, MI, stroke, or refractory ischemia.

CONTRAINDICATIONS

The use of PLAVIX is contraindicated in the following conditions:

- Hypersensitivity to the drug substance or any component of the product.
- Active pathological bleeding such as peptic ulcer or intracranial hemorrhage.

WARNINGS

Thrombotic thrombocytopenic purpura (TTP):

TTP has been reported rarely following use of PLAVIX, sometimes after a short exposure (<2 weeks). TTP is a serious condition that can be fatal and requires urgent treatment including plasmapheresis (plasma exchange). It is characterized by thrombocytopenia, microangiopathic hemolytic anemia (schistocytes [fragmented RBCs] seen on peripheral smear), neurological findings, renal dysfunction, and fever. (See **ADVERSE REACTIONS**.)

PRECAUTIONS

General

PLAVIX prolongs the bleeding time and therefore should be used with caution in patients who may be at risk of increased bleeding from trauma, surgery, or other pathological conditions (particularly gastrointestinal and intraocular). If a patient is to undergo elective surgery and an antiplatelet effect is not desired, PLAVIX should be discontinued 5 days prior to surgery.

Due to the risk of bleeding and undesirable hematological effects, blood cell count determination and/or other appropriate testing should be promptly considered, whenever such suspected clinical symptoms arise during the course of treatment (see **ADVERSE REACTIONS**).

In patients with recent TIA or stroke who are at high risk for recurrent ischemic events, the combination of aspirin and PLAVIX has not been shown to be more effective than PLAVIX alone, but the combination has been shown to increase major bleeding.

GI Bleeding: In CAPRIE, PLAVIX was associated with a rate of gastrointestinal bleeding of 2.0%, vs. 2.7% on aspirin. In CURE, the incidence of major gastrointestinal bleeding was 1.3% vs 0.7% (PLAVIX + aspirin vs. placebo + aspirin, respectively). PLAVIX should be used with caution in patients who have lesions with a propensity to bleed (such as ulcers). Drugs that might induce such lesions should be used with caution in patients taking PLAVIX.

Use in Hepatically Impaired Patients: Experience is limited in patients with severe hepatic disease, who may have bleeding diatheses. PLAVIX should be used with caution in this population.

Use in Renally-impaired Patients: Experience is limited in patients with severe renal impairment. PLAVIX should be used with caution in this population.

Information for Patients

Patients should be told it may take them longer than usual to stop bleeding, that they may bruise and/or bleed more easily when they take PLAVIX or PLAVIX combined with aspirin, and that they should report any unusual bleeding to their physician. Patients should inform physicians and dentists that they are taking PLAVIX and/or any other product known to affect bleeding before any surgery is scheduled and before any new drug is taken.

Drug Interactions

Study of specific drug interactions yielded the following results:

Aspirin: Aspirin did not modify the clopidogrel-mediated inhibition of ADP-induced platelet aggregation. Concomitant administration of 500 mg of aspirin twice a day for 1 day did not significantly increase the prolongation of bleeding time induced by PLAVIX. PLAVIX potentiated the effect of aspirin on collagen-induced platelet aggregation. PLAVIX and aspirin have been administered together for up to one year.

Heparin: In a study in healthy volunteers, PLAVIX did not necessitate modification of the heparin dose or alter the effect of heparin on coagulation. Coadministration of heparin had no effect on inhibition of platelet aggregation induced by PLAVIX.

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs): In healthy volunteers receiving naproxen, concomitant administration of PLAVIX was associated with increased occult gastrointestinal blood loss. NSAIDs and PLAVIX should be coadministered with caution.

Warfarin: Because of the increased risk of bleeding, the concomitant administration of warfarin with PLAVIX should be undertaken with caution. (See **PRECAUTIONS– General.**)

Other Concomitant Therapy: No clinically significant pharmacodynamic interactions were observed when PLAVIX was coadministered with **atenolol, nifedipine,** or both atenolol and nifedipine. The pharmacodynamic activity of PLAVIX was also not significantly influenced by the coadministration of **phenobarbital, cimetidine** or **estrogen.**

The pharmacokinetics of **digoxin** or **theophylline** were not modified by the coadministration of PLAVIX (clopidogrel bisulfate).

At high concentrations *in vitro*, clopidogrel inhibits P_{450} (2C9). Accordingly, PLAVIX may interfere with the metabolism of **phenytoin, tamoxifen, tolbutamide, warfarin, torsemide, fluvastatin,** and many **non-steroidal anti-inflammatory agents**, but there are no data with which to predict the magnitude of these interactions. Caution should be used when any of these drugs is coadministered with PLAVIX.

In addition to the above specific interaction studies, patients entered into clinical trials with PLAVIX received a variety of concomitant medications including **diuretics, beta-blocking agents, angiotensin converting enzyme inhibitors, calcium antagonists, cholesterol lowering agents, coronary vasodilators, antidiabetic agents** (including **insulin**), **antiepileptic agents, hormone replacement therapy, heparins** (unfractionated and LMWH) and **GPIIb/IIIa antagonists** without evidence of clinically significant adverse interactions. The use of oral anticoagulants, non-study anti-platelet drug and chronic NSAIDs was not allowed in CURE and there are no data on their concomitant use with clopidogrel.

Drug/Laboratory Test Interactions

None known.

Carcinogenesis, Mutagenesis, Impairment of Fertility

There was no evidence of tumorigenicity when clopidogrel was administered for 78 weeks to mice and 104 weeks to rats at dosages up to 77 mg/kg per day, which afforded plasma exposures >25 times that in humans at the recommended daily dose of 75 mg.

Clopidogrel was not genotoxic in four *in vitro* tests (Ames test, DNA-repair test in rat hepatocytes, gene mutation assay in Chinese hamster fibroblasts, and metaphase chromosome analysis of human lymphocytes) and in one *in vivo* test (micronucleus test by oral route in mice).

Clopidogrel was found to have no effect on fertility of male and female rats at oral doses up to 400 mg/kg per day (52 times the recommended human dose on a mg/m² basis).

Pregnancy

Pregnancy Category B. Reproduction studies performed in rats and rabbits at doses up to 500 and 300 mg/kg/day (respectively, 65 and 78 times the recommended daily human dose on a mg/m² basis), revealed no evidence of impaired fertility or fetotoxicity due to clopidogrel. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of a human response, PLAVIX should be used during pregnancy only if clearly needed.

Nursing Mothers

Studies in rats have shown that clopidogrel and/or its metabolites are excreted in the milk. It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk and because of the potential for serious adverse reactions in nursing infants, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the nursing woman.

Pediatric Use

Safety and effectiveness in the pediatric population have not been established.

Geriatric Use

Of the total number of subjects in controlled clinical studies, approximately 50% of patients treated with PLAVIX were years of age and over. Approximately 16% of patients treated with PLAVIX were 75 years of age and over.

The observed difference in risk of thrombotic events with clopidogrel plus aspirin versus placebo plus aspirin by age category is provided in Figure 3 (see **CLINICAL STUDIES**). The observed difference in risk of bleeding events with clopidogrel plus aspirin versus placebo plus aspirin by age category is provided in Table 3 (see **ADVERSE REACTIONS**).

ADVERSE REACTIONS

PLAVIX has been evaluated for safety in more than 17,500 patients, including over 9,000 patients treated for 1 year or more. The overall tolerability of PLAVIX in CAPRIE was similar to that of aspirin regardless of age, gender and race, with approximately equal incidence (13%) of patients withdrawing from treatment because of adverse reactions. The clinically important adverse events observed in CAPRIE and CURE are discussed below.

Hemorrhagic: In CAPRIE patients receiving PLAVIX, gastrointestinal hemorrhage occurred at a rate of 2.0%, and required hospitalization in 0.7%. In patients receiving aspirin, the corresponding rates were 2.7% and 1.1%, respectively. The incidence of intracranial hemorrhage was 0.4% for PLAVIX compared to 0.5% for aspirin.

In CURE, PLAVIX use with aspirin was associated with an increase in bleeding compared to placebo with aspirin (see Table 3). There was an excess in major bleeding in patients receiving PLAVIX plus aspirin compared with placebo plus aspirin, primarily gastrointestinal and at puncture sites. The incidence of intracranial hemorrhage (0.1%), and fatal bleeding (0.2%), were the same in both groups.

The overall incidence of bleeding is described in Table 3 for patients receiving both PLAVIX and aspirin in CURE,

Table 3: CURE Incidence of bleeding complications (% patients)

Event	PLAVIX (+ aspirin)* (n=6259)	Placebo (+ aspirin)* (n=6303)	P-value
Major bleeding †	3.7 ‡	2.7 §	0.001
Life-threatening bleeding	2.2	1.8	0.13
Fatal	0.2	0.2	
5 g/dL hemoglobin drop	0.9	0.9	
Requiring surgical intervention	0.7	0.7	
Hemorrhagic strokes	0.1	0.1	
Requiring inotropes	0.5	0.5	
Requiring transfusion (≥4 units)	1.2	1.0	
Other major bleeding	1.6	1.0	0.005
Significantly disabling	0.4	0.3	
Intraocular bleeding with significant loss of vision	0.05	0.03	
Requiring 2-3 units of blood	1.3	0.9	
Minor bleeding ¶	5.1	2.4	<0.001

* Other standard therapies were used as appropriate.

† Life threatening and other major bleeding.

‡ Major bleeding event rate for PLAVIX + aspirin was dose-dependent on aspirin: <100 mg=2.6%; 100-200 mg= 3.5%; >200 mg=4.9%
Major bleeding event rates for PLAVIX + aspirin by age were: <65 years = 2.5%, ≥65 to <75 years = 4.1%, ≥75 years 5.9%

§ Major bleeding event rate for placebo + aspirin was dose-dependent on aspirin: <100 mg=2.0%; 100-200 mg= 2.3%; >200 mg=4.0%
Major bleeding event rates for placebo + aspirin by age were: <65 years = 2.1%, ≥65 to <75 years = 3.1%, ≥75 years 3.6%

¶ Led to interruption of study medication.

Ninety-two percent (92%) of the patients in the CURE study received heparin/LMWH, and the rate of bleeding in these patients was similar to the overall results.

There was no excess in major bleeds within seven days after coronary bypass graft surgery in patients who stopped therapy more than five days prior to surgery (event rate 4.4% PLAVIX + aspirin; 5.3% placebo + aspirin). In patients who remained on therapy within five days of bypass graft surgery, the event rate was 9.6% for PLAVIX + aspirin, and 6.3% for placebo + aspirin.

Neutropenia/agranulocytosis: Ticlopidine, a drug chemically similar to PLAVIX, is associated with a 0.8% rate of severe neutropenia (less than 450 neutrophils/μL). In CAPRIE severe neutropenia was observed in six patients, four on PLAVIX and two on aspirin. Two of the 9599 patients who received PLAVIX and none of the 9586 patients who received aspirin had neutrophil counts of zero. One of the four PLAVIX patients in CAPRIE was receiving cytotoxic chemotherapy, and another recovered and returned to the trial after only temporarily interrupting treatment with PLAVIX (clopidogrel bisulfate). In CURE, the numbers of patients with thrombocytopenia (19 PLAVIX + aspirin vs. 24 placebo + aspirin) or neutropenia (3 vs. 3) were similar.

Although the risk of myelotoxicity with PLAVIX (clopidogrel bisulfate) thus appears to be quite low, this possibility should be considered when a patient receiving PLAVIX demonstrates fever or other sign of infection.

Gastrointestinal: Overall, the incidence of gastrointestinal events (e.g. abdominal pain, dyspepsia, gastritis and constipation) in patients receiving PLAVIX (clopidogrel bisulfate) was 27.1%, compared to 29.8% in those receiving aspirin in the CAPRIE trial. In the CURE trial the incidence of these gastrointestinal events for patients receiving PLAVIX + aspirin was 11.7% compared to 12.5% for those receiving placebo + aspirin.

In the CAPRIE trial, the incidence of peptic, gastric or duodenal ulcers was 0.7% for PLAVIX (clopidogrel bisulfate) and 1.2% for aspirin. In the CURE trial the incidence of peptic, gastric or duodenal ulcers was 0.4% for PLAVIX + aspirin and 0.3% for placebo + aspirin.

Cases of diarrhea were reported in the CAPRIE trial in 4.5% of patients in the PLAVIX group compared to 3.4% in the aspirin group. However, these were rarely severe (PLAVIX=0.2% and aspirin=0.1%). In the CURE trial, the incidence of diarrhea for patients receiving PLAVIX + aspirin was 2.1% compared to 2.2% for those receiving placebo + aspirin.
In the CAPRIE trial, the incidence of patients withdrawing from treatment because of gastrointestinal adverse reactions was 3.2% for PLAVIX and 4.0% for aspirin. In the CURE trial, the incidence of patients withdrawing from treatment because of gastrointestinal adverse reactions was 0.9% for PLAVIX + aspirin compared with 0.8% for placebo + aspirin.
Rash and Other Skin Disorders: In the CAPRIE trial, the incidence of skin and appendage disorders in patients receiving PLAVIX was 15.8% (0.7% serious); the corresponding rate in aspirin patients was 13.1% (0.5% serious). In the CURE trial the incidence of rash ■ other skin disorders in patients receiving PLAVIX + aspirin was 4.0% compared to 3.5% for those receiving placebo + aspirin.
In the CAPRIE trial, the overall incidence of patients withdrawing from treatment because of skin and appendage disorders adverse reactions was 1.5% for PLAVIX and 0.8% for aspirin. In the CURE trial, the incidence of patients withdrawing because of skin and appendage disorders adverse reactions was 0.7% for PLAVIX + aspirin compared with 0.3% for placebo + aspirin.
Adverse events occurring in ≥2.5% of patients on PLAVIX in the CAPRIE controlled clinical trial are shown below regardless of relationship to PLAVIX. The median duration of therapy was 20 months, with a maximum of 3 years.

Table 4: Adverse Events Occurring in ≥2.5% of PLAVIX Patients in CAPRIE

	% Incidence	(% Discontinuation)
Body System **Event**	**PLAVIX [n=9599]**	**Aspirin [n=9586]**
Body as a Whole – general disorders		
Chest Pain	8.3 (0.2)	8.3 (0.3)
Accidental/Inflicted Injury	7.9 (0.1)	7.3 (0.1)
Influenza-like symptoms	7.5 (<0.1)	7.0 (<0.1)
Pain	6.4 (0.1)	6.3 (0.1)
Fatigue	3.3 (0.1)	3.4 (0.1)
Cardiovascular disorders, general		
Edema	4.1 (<0.1)	4.5 (<0.1)
Hypertension	4.3 (<0.1)	5.1 (<0.1)
Central & peripheral nervous system disorders		
Headache	7.6 (0.3)	7.2 (0.2)
Dizziness	6.2 (0.2)	6.7 (0.3)
Gastrointestinal system disorders		
Abdominal pain	5.6 (0.7)	7.1 (1.0)
Dyspepsia	5.2 (0.6)	6.1 (0.7)
Diarrhea	4.5 (0.4)	3.4 (0.3)
Nausea	3.4 (0.5)	3.8 (0.4)
Metabolic & nutritional disorders		
Hypercholesterolemia	4.0 (0)	4.4 (<0.1)
Musculo-skeletal system disorders		
Arthralgia	6.3 (0.1)	6.2 (0.1)
Back Pain	5.8 (0.1)	5.3 (<0.1)
Platelet, bleeding, & clotting disorders		
Purpura/Bruise	5.3 (0.3)	3.7 (0.1)
Epistaxis	2.9 (0.2)	2.5 (0.1)
Psychiatric disorders		
Depression	3.6 (0.1)	3.9 (0.2)
Respiratory system disorders		
Upper resp tract infection	8.7 (<0.1)	8.3 (<0.1)
Dyspnea	4.5 (0.1)	4.7 (0.1)
Rhinitis	4.2 (0.1)	4.2 (<0.1)
Bronchitis	3.7 (0.1)	3.7 (0)
Coughing	3.1 (<0.1)	2.7(<0.1)
Skin & appendage disorders		
Rash	4.2 (0.5)	3.5 (0.2)
Pruritus	3.3 (0.3)	1.6 (0.1)
Urinary system disorders		
Urinary tract infection	3.1 ■	3.5 (0.1)

Incidence of discontinuation, regardless of relationship to therapy, is shown in parentheses.
Adverse events occurring in ≥2.0% of patients on PLAVIX in the CURE controlled clinical trial are shown below regardless of relationship to PLAVIX.

Table 5: Adverse Events Occurring in ≥2.0% of PLAVIX Patients in CURE

	■ Incidence	(% Discontinuation)
Body System **Event**	**PLAVIX (+ aspirin)* [n=6259]**	**Placebo (+ aspirin)* [n=6303]**
Body as a Whole– general disorders		
Chest Pain	2.7 (<0.1)	2.8 (0.0)
Central & peripheral nervous system disorders		
Headache	3.1 (0.1)	3.2 (0.1)
Dizziness	2.4 (0.1)	2.0 (<0.1)
Gastrointestinal system disorders		
Abdominal pain	2.3 (0.3)	2.8 (0.3)
Dyspepsia	2.0 (0.1)	1.9 (<0.1)
Diarrhea	2.1 (0.1)	2.2 (0.1)

*Other standard therapies were used as appropriate.

Other adverse experiences of potential importance occurring in 1% to 2.5% of patients receiving PLAVIX (clopidogrel bisulfate) in the CAPRIE or CURE controlled clinical trials are listed below regardless of relationship to PLAVIX. In general, the incidence of these events was similar to that in patients receiving aspirin (in CAPRIE) or placebo + aspirin (in CURE).
Autonomic Nervous System Disorders: Syncope, Palpitation. *Body as a Whole-general disorders:* Asthenia, Fever, Hernia. *Cardiovascular disorders:* Cardiac failure. *Central and peripheral nervous system disorders:* Cramps legs, Hypoaesthesia, Neuralgia, Paraesthesia, Vertigo. *Gastrointestinal system disorders:* Constipation, Vomiting. *Heart rate and rhythm disorders:* Fibrillation atrial. *Liver and biliary system disorders:* Hepatic enzymes increased. *Metabolic and nutritional disorders:* Gout, hyperuricemia, non-protein nitrogen (NPN) increased. *Musculo-skeletal system disorders:* Arthritis, Arthrosis. *Platelet, bleeding & clotting disorders:* GI hemorrhage, hematoma, platelets decreased. *Psychiatric disorders:* Anxiety, Insomnia. *Red blood cell disorders:* Anemia. *Respiratory system disorders:* Pneumonia, Sinusitis. *Skin and appendage disorders:* Eczema, Skin ulceration. *Urinary system disorders:* Cystitis. *Vision disorders:* Cataract, Conjunctivitis.
Other potentially serious adverse events which may be of clinical interest but were rarely reported (<1%) in patients who received PLAVIX in the CAPRIE or CURE controlled clinical trials are listed below regardless of relationship to PLAVIX. In general, the incidence of these events was similar to that in patients receiving aspirin (in CAPRIE) or placebo + aspirin (in CURE).
Body as a whole: Allergic reaction, necrosis ischemic. *Cardiovascular disorders:* Edema generalized. *Gastrointestinal system disorders:* Gastric ulcer perforated, gastritis hemorrhagic, upper GI ulcer hemorrhagic. *Liver and Biliary system disorders:* Bilirubinemia, hepatitis infectious, liver fatty. *Platelet, bleeding and clotting disorders:* hemarthrosis, hematuria, hemoptysis, hemorrhage intracranial, hemorrhage retroperitoneal, hemorrhage of operative wound, ocular hemorrhage, pulmonary hemorrhage, purpura allergic, thrombocytopenia. *Red blood cell disorders:* Anemia aplastic, anemia hypochromic. *Reproductive disorders, female:* Menorrhagia. *Respiratory system disorders:* Hemothorax. *Skin and appendage disorders:* Bullous eruption, rash erythematous, rash maculopapular, urticaria. *Urinary system disorders:* Abnormal renal function, acute renal failure. *White cell and reticuloendothelial system disorders:* Agranulocytosis, granulocytopenia, leukemia, leukopenia, neutrophils decreased.

Postmarketing Experience
The following events have been reported spontaneously from worldwide postmarketing experience:

- *Body as a whole:*
  -hypersensitivity reactions, anaphylactoid reactions, serum sickness
- *Central and Peripheral Nervous System disorders:*
  -confusion, hallucinations, taste disorders
- *Hepato-biliary disorders:*
  -abnormal liver function test, hepatitis (non-infectious), acute liver failure
- *Platelet, Bleeding and Clotting disorders:*
  -cases of bleeding with fatal outcome (especially intracranial, gastrointestinal and retroperitoneal hemorrhage)
  -thrombotic thrombocytopenic purpura (TTP) – some cases with fatal outcome- (see **WARNINGS**).
  -agranulocytosis, aplastic anemia/pancytopenia
  -conjunctival, ocular and retinal bleeding
- *Respiratory, thoracic and mediastinal disorders:*
  -bronchospasm, interstitial pneumonitis
- *Skin and subcutaneous tissue disorders:*
  -angioedema, erythema multiforme, Stevens-Johnson syndrome, toxic epidermal necrolysis, lichen planus
- *Renal and urinary disorders:*
  - glomerulopathy, increased creatinine levels
- *Vascular disorders:*
  - vasculitis, hypotension
- *Gastrointestinal disorders:*
  - colitis (including ulcerative or lymphocytic colitis), pancreatitis, stomatitis
- *Musculoskeletal, connective tissue and bone disorders:*
  - myalgia

OVERDOSAGE

Overdose following clopidogrel administration may lead to prolonged bleeding time and subsequent bleeding complications. A single oral dose of clopidogrel at 1500 or 2000 mg/kg was lethal to mice and to rats and at 3000 mg/kg to baboons. Symptoms of acute toxicity were vomiting (in baboons), prostration, difficult breathing, and gastrointestinal hemorrhage in all species.

Recommendations About Specific Treatment:
Based on biological plausibility, platelet transfusion may be appropriate to reverse the pharmacological effects of PLAVIX if quick reversal is required.

DOSAGE AND ADMINISTRATION

Recent MI, Recent Stroke, or Established Peripheral Arterial Disease
The recommended daily dose of PLAVIX is 75 mg once daily.

Acute Coronary Syndrome
For patients with acute coronary syndrome (unstable angina/non-Q-wave MI), PLAVIX should be initiated with a single 300 mg loading dose and then continued at 75 mg once daily. Aspirin (75 mg-325 mg once daily) should be initiated and continued in combination with PLAVIX. In CURE, most patients with Acute Coronary Syndrome also received heparin acutely (see **CLINICAL STUDIES**).
PLAVIX can be administered with or without food.
No dosage adjustment is necessary for elderly patients or patients with renal disease. (See **Clinical Pharmacology: Special Populations.**)

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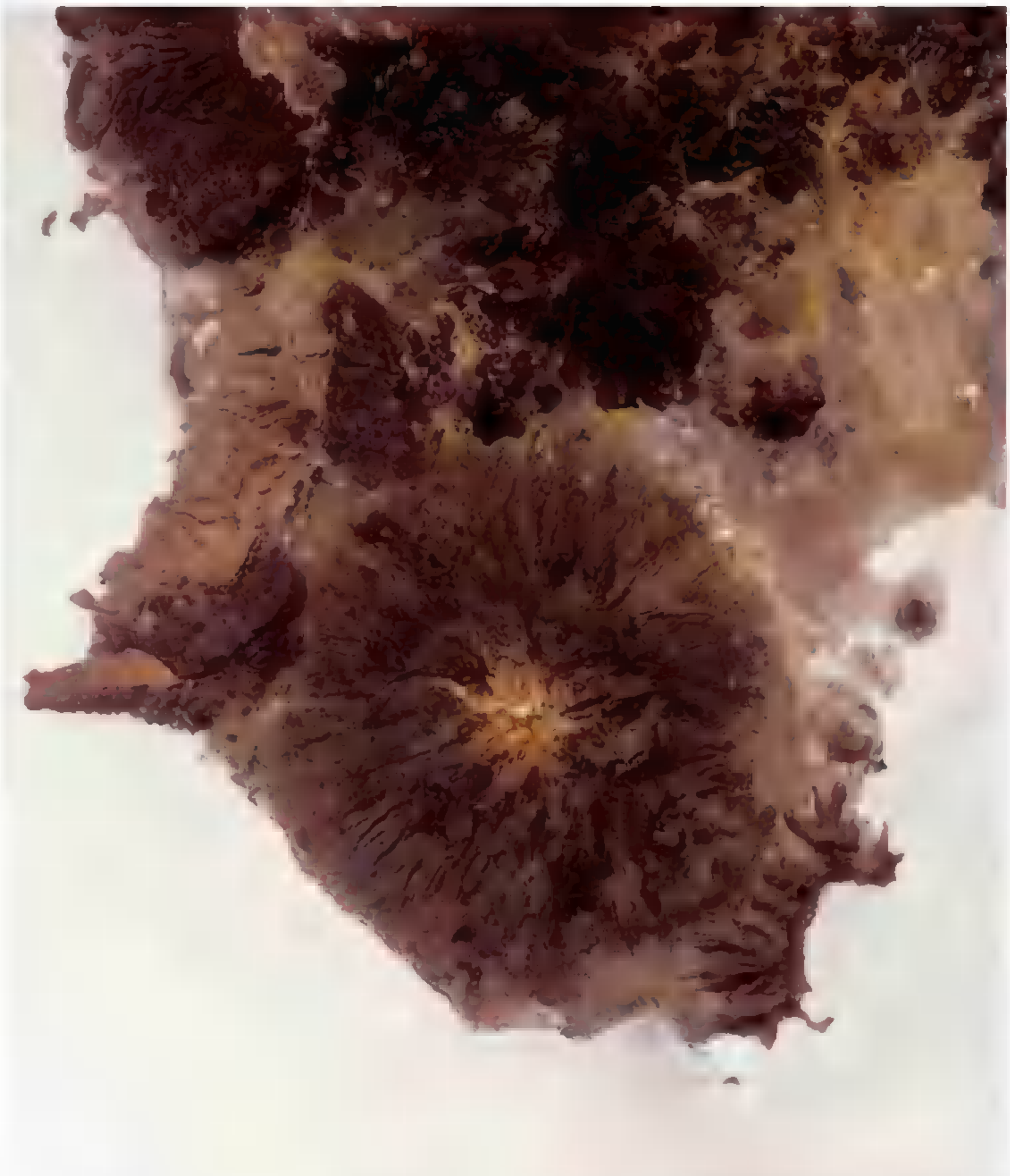
Brief Summary of Prescribing Information Revised February 2006

PLA-FEB06-B-Af

WHERE IN THE WORLD?



More than ten billion tons of salt are contained within Bolivia's Salar de Uyuni.

Above the Salt Largest in the world, Bolivia's vast Salar de Uyuni salt flat laps at the base of Mount Tunupa, an inactive volcano considered sacred by local Quechua people. Nestled high in the southwestern reaches of the country's Altiplano region, the 3,000-square-mile Salar is the site of an inland lake that evaporated about 10,000 years ago. Even the briefest rain creates pools of water atop the hard white desert's surface, becoming temporary mirrors for the sky. *—Whitney Dangerfield*

PHOTO: IMAGE SCIENCE AND ANALYSIS LABORATORY, NASA JOHNSON SPACE CENTER

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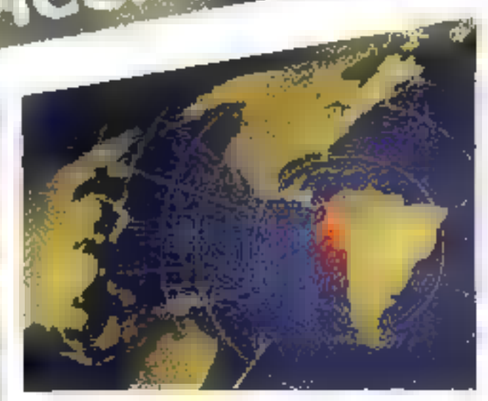

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PRACTICAL GUIDE/ USEFUL DATA

Location, and boundaries

With 1.285.215.6 km*, equivalent to the area of France, Spain and Germany put together.

Language

Spanish is the official language of the country; nevertheless, other Andean and Amazonic native languages are officially recognized. It is possible to communicate in English with persons providing tourist services, such as official tourist guides, Travel Agency personnel and receptionists at airports and hotels.

Currency

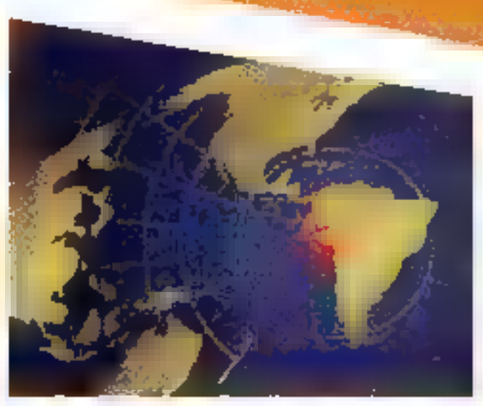
The official currency of Peru is the Nuevo Sol (S/.). The US dollar is accepted in the majority of commercial premises, restaurants and service stations. The great majority of lodging houses and urban establishments accept credit cards. The use of Euros and travelers' checks is not very widespread.

How to come

Direct flights and with connections from the main European, Asian and American cities. The main entry point is the Jorge Chavez International Airport (Callao, Lima), www.lap.com.pe.

Airport tax (For use of airport) (T.U.U.A.)

International flights: US$ 30.25. Payment must be made in cash before boarding the flight.



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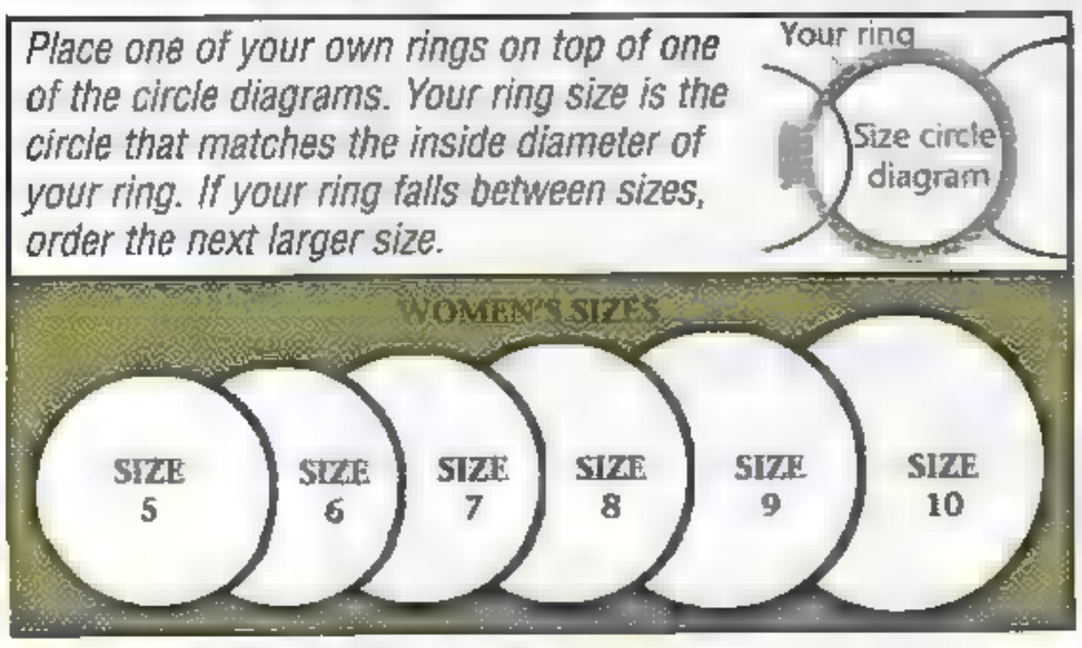
Our scientifically impeccable DiamondAura Canary Ring displays the many hues of a radiant sunrise for only a fraction of the cost.

My 5th generation Belgium gem broker is at the top of his trade and enjoys finding a special gem with a certain size, shape, color and clarity—he doesn't trade in what is available on the local market. During our visit, he proudly displayed a brilliant round-cut Canary diamond, explaining that natural yellow color diamonds are 10,000 times more rare than their brilliant white, colorless counterparts. Turning the stone in the light, he said the intensity of color is of paramount importance, and clarity increases the inherent value of a high-quality color diamond. He said this fine Canary Yellow gemstone, framed by two white diamonds, should retail for a minimum of $10,000. As my broker admired this treasure, I decided now was the time for a little amusement.

As he glanced away, I placed a similarly colored lab-created yellow Diamond*Aura* ring next to the natural mined diamond. My broker thought he was seeing double. After close examination he was astonished—the faultless, lab-created oval-cut Diamond*Aura* was so visually similar in almost every way! He started to wonder about the future of the diamond business.

We were inspired by it's radiant color. Influenced by the ultra-rare Canary diamond, we went to the gemological laboratory to craft this extraordinary jewelry using lab-created Diamond*Aura* that are practically indistinguishable to the naked eye from mined diamonds. Our Diamond*Auras* are heated to over 5000 degrees in very expensive state-of-the-art lab equipment to create Diamond*Aura*. The ring features an oval-cut canary Diamond*Aura* set in the center with two oval-cut white Diamond*Auras* on either side, for a total carat weight of over 5.5 carats. The center canary Diamond*Aura* will tantalize the eyes with its radiating color as the two white Diamond*Aura*s that surround it glint and sparkle upon your hand. The band is .925 sterling silver that won't tarnish over time. Truly affordable elegance!



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Flying Serpents

A snake's unlikely move offers an intriguing twist for scientists studying the biomechanics of flight.

Chrysopelea paradisi, a Southeast Asian tree snake, can fling itself into the sky from a tree branch above, and curving like an S shape, "fly" through the air to another perch.

"This is gliding flight," explains Jake Socha, a biomechanist who spent years filming and videotaping the snakes' movements. "They can't move upwards, but they can gain significant distance and even turn in the air." The higher the launch site, the farther a snake can glide.

Socha found that a flying snake fans its ribs; its belly becomes concave and the width of its body doubles (left). The contortion ups the ratio of air-foil area to body weight, improving aerodynamics.

Gliding flight is especially useful in forests of huge trees where sailing through the canopy is more efficient than climbing up and down. Seasoned gliders include flying squirrels, some lizard and frog species and even a wingless tropical ant. The snake, though, is "an extreme example of what evolution can do," Socha says. "It tells you that an animal's body form doesn't always predict its behavior. In fact, I can't think of many worse shapes to fly than a long cylinder if you want to fly." —*Jennifer S. Holland*

PHOTO: TIM LAMAN; ART: TARA DALTON

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Heavy exploration requires a lightweight camera. Enter the new Sony αDSLR A-100.

Freelance photographer and Grand Canyon river guide David Edwards knows a thing or two about taking pictures inside one of our world's greatest wonders. Having recently completed a nine-day photo assignment during the Canyon's monsoon season, Edwards and his dog Molly set off to capture dramatic clouds and rainbows with his lightweight and easy-to-use Sony αDSLR A-100. "Lightness is important in remote areas like the Canyon. You don't want a heavy camera pack to throw you off balance," he says. Edwards also likes the model's large view screen and access to images. "The thing you look for as a pro is contrast and composition—and I like what I saw," Edwards adds. "I was able to take images and increase and decrease exposure with great ease." Edwards sat with Molly at the South Rim's Havasupai Point—in the rain—waiting for his perfect shot. "I set myself up to get the long light, and at one point, I turned around and saw a 360-degree rainbow, part of it just 30-40 yards from me. It was just incredible."

Photos: David Edwards

Sony αDSLR A-100

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Doomed Beauty

Lady Jane Grey ruled England for only nine days in the turbulent period following the death of King Henry VIII. After Mary Tudor took power in 1553, Jane, just 16 years old, was locked up and soon beheaded. Until recently she was one of history's fleeting shadows. Now a painting in a private collection has been identified as probably her only surviving likeness. The clothing and jewels fit, as does the name, upper left, in ■ historically accurate pigment. The oak panels under the paint date from about 1595, so this image must be a copy of an original, now lost.

Another clue lies in scratches inflicted on the painted face, perhaps ■ symbolic, political attack, even if done long after her death. "If you're just a noblewoman," says Libby Sheldon, an art historian at University College London, "it's very unlikely someone would do that sort of damage to you." *—A. R. Williams*

Fresh Dirt

Lying under a thin layer of earth, ■ silver whistle two and a half inches long set off Keith Stuart's metal detector last year as he swept across a field on the Isle of Wight during an outing of a metal-detecting club. At first Stuart thought the object was ■ modern toy, but local archaeologist Frank Basford identified it as something very old. Research turned up possible royal connections for the designs that alternate along the whistle's chevron band: the English rose, a symbol of the Tudor dynasty, and a pomegranate, the personal insignia of Catherine of Aragon, King Henry VIII's first wife. Might the monarch, or one of his entourage, have dropped this whistle during ■ visit to the island in 1538?

Basford described the find as ■ 16th-century huntsman's whistle, probably used to call birds. It had surely been owned by someone wealthy enough to afford silver—but a king? That's impossible to prove.

In any case, such a fine whistle would have been rare on the poor island, and the county museum now wants to buy it. For Stuart, the possibility of royal ownership will always be a tantalizing part of the whistle's story. "It's got royal emblems," he says. "Who else would dare use it? He'd get his head chopped off."

TOP: LANE FINE ART; PHOTO BY A. C. COOPER LTD. BOTTOM: ISLE OF WIGHT COUNCIL

Gone are the rules that say you must be somewhere, at some time, for something. Posted nowhere is the schedule for when you must eat, where you must eat or who you must eat with. There is no official decree for when you must play or where you must nap. That's what Freestyle Cruising® is all about. It's a relatively must-free cruise. Visit ncl.com, dial 1.866.234.0292 or call your travel professional.

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War Zone Gorillas Park rangers in eastern Congo have been wounded, kidnapped, and murdered. Even their familes have been targeted by armed factions that continue to roam the region three years after the official end to the Democratic Republic of the Congo's civil war. Before the fighting began, the park was home to 8,000 of rare Grauer's gorillas, the largest concentration of the world's estimated 17,000. Poaching for meat and profit, combined with habitat destruction, has since reduced the total population of apes, also known as eastern lowland gorillas, by as much as 70 percent. But fighting has dropped off enough to allow rangers to begin answering a pressing question: How many Grauer's gorillas remain?

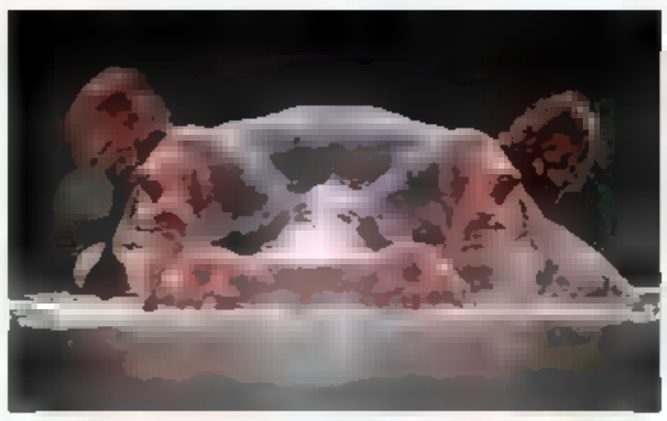
The news from the park's higher elevations is good: The most recent survey there found 170 gorillas—up from 130 in 2000. The rangers have also begun to venture into the park's lower elevations to count what should be a larger group of survivors. The fighting may have subsided some, but the rangers' work remains dangerous, says Carlos Schuler-Deschryver, a researcher with a German organization that helps fund the park. "We have attacks on rangers nearly every day."

—Karen E. Lange

Photo Gallery See more gorilla images at **ngm.com/0103.**

Other animal populations hurt by wars:

- **Edwards's pheasant** These birds were once common in central Vietnam. Herbicides sprayed during the Vietnam War destroyed habitat.
- **Dibatag, or Clarke's gazelle** Ongoing conflict in Somalia has damaged grassland habitat and led to severe over-hunting.
- **Hippopotomus** They're officially protected throughout sub-Saharan Africa, but poaching soars during strife. The Democratic Republic of the Congo's population has shrunk 95 percent since 1996.



PHOTOS: CARLOS SCHULER-DESCHYLER (TOP); FRANS LANTING

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Partners in health

Dust [illegible] to [illegible] suit after a 1972 moonwalk.

Smelling Moondust Moonwalking is dirty work. After taking off his helmet following a lunar excursion, Apollo 17 commander Eugene Cernan reported a common impression: The dust covering him (above) smelled surprisingly like spent gunpowder. Cernan's pilot Harrison Schmitt, the only geologist among the 12 men who have walked on the moon, has suggested that the fine powder (boot print, left) houses fractured chemical bonds that latch onto receptors in the nose. Schmitt even got a temporary touch of lunar "hay fever" after removing his suit. Gary Lofgren of NASA's Astromaterials Curation Lab agrees. He reasons that oxygen and moisture in the lunar landers must have reacted with the moondust, which is composed of about half silicon dioxide–rich glass formed by meteorite bombardment, with the rest mostly iron, calcium, magnesium, olivine, and pyroxene. Lofgren doubts that tiny traces of sulfur in this mix could account for the gunpowder smell. As NASA prepares to send humans back to the moon in 2018, the odd odor may be ■ question that will get answered in a lunar lab a bit closer to the source. —*Michael Klesius*

What's New?

Life in space is bad for bones. Scientists know that microgravity conditions reduce bone mass. But ■ new study by Clemson University researchers indicates that bone loss also occurs in mice exposed to radiation similar to that which astronauts will receive during Mars or moon missions. In mice as well ■ humans, the spongy inner bone tissue damaged by radiation cannot generally be replaced once lost.

The first star may have been born tens of millions of years earlier than once thought. Tel Aviv University astrophysicists now peg its origins to just 30 million years post-big bang—which itself occurred 13.7 billion years ago.

PHOTOS: NASA JOHNSON SPACE CENTER (TOP); NASA

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Sun Prints

When he was a boy, Binh Danh observed how green beneath a leaf left in the sun turned yellow. Later, while studying photography, he learned that 19th-century artists transferred pictures to plants in much the same way—by strategically blocking light, thereby preventing chlorophyll production. Danh, who emigrated as a child to the United States from Vietnam, adopted the medium for photo studies of his homeland and the remnants of war in Southeast Asia. —*Dan Carroll*

Step 1 Danh starts by making a computer-printed negative of the image to be transferred to a plant.

Step 2 He sandwiches the negative, the plant and a moist cloth—to keep the plant alive—in a contact-printing frame.

Step 3 Left outside, the packet soaks in sun for two to four weeks.

Step 4 Danh dries the leaf with silica gel and preserves it in a clear resin cast. His works range in size from several inches to more than four feet across.

The face of Danh's grandfather from an aroid leaf.

A philodendron leaf holds the portrait of a victim of Cambodia's killing fields.

A branch bears pictures of children kept prisoner in Cambodian camps in the 1970s.

More than the color of their parts: Green onions capture an elusive Buddha.

PHOTOS: BINH DANH, HAINES GALLERY

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A young banded mongoose catches a nap on the back of a caregiver.

NG GRANTEE **Mongoose Family Values** Banded mongooses may practice the most extreme form of collective parenting on the planet. Like many species, these African mammals work together to raise young. Giving birth about the same time, mothers communally suckle the young in the den for three to four weeks. After that, though, young mongooses must arrange for their own care. Each pup picks a young adult in their pack, usually a male, and chirps ceaselessly—up to 70 times a minute—until the adult either chases it off or brings it food. The pup develops a bond with this older caregiver, who feeds it for up to a month. "It's fantastically strange," says Matt Bell, who studied mongooses in Uganda's Queen Elizabeth National Park with funding from National Geographic. "It's like a hippie community." *—Neil Shea*

PHOTO: ANUP SHAH

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Plug Load Play

Killer Mice Nearly a million Tristan albatrosses and Atlantic petrels die each year on Gough Island in the South Atlantic. Now researchers have nabbed the killers—mice most likely descended from stowaways on ships that sailed there in the 1800s. After eating their way through local insects, the ravenous mice turned to seabird chicks, which are up to 250 times the size of their attackers. Exhibiting rat-like behavior never before seen in house mice, the rodents swarm a nest-bound chick—even tucked under ■ parent—and gnaw through the bird's down and skin. With no evolutionary sense of danger, says researcher Ross Wanless, the chicks simply sit through the attack. Some birds are eaten alive; others die within days of blood loss or infection. This year, the Royal Society for the Protection of Birds received a grant to study the feasibility of eradicating the mice to save the birds. —*Whitney Dangerfield*

Animal Watch

Even baboons get the blues. Sylvia, ■ 23-year-old baboon in Botswana's Okavango Delta, had been the queen of mean. But after ■ lion killed Sierra, her daughter and grooming partner, Sylvia changed. She began to reach out to baboons of much lower rank. Testing showed that the friendly social contact lowered the stress hormones that had spiked in her system after the death of her daughter. Baboons may not feel human-like grief, but researchers say Sylvia's response suggests that the monkeys need social relationships to help them cope with stress.

The higher ■ female wasp ranks, the less likely she is to work. A new study finds that among tropical hairy-faced hover wasps, non-queens waited in an age-based queue for a chance at being the sole breeder, or queen, of the group. Rather than expend energy and risk death foraging to feed the current queen's larvae, as younger females do, older, higher ranking wasps rest quietly in the hive. Previously, scientists had theorized that the amount of time spent foraging and helping the group depended on how closely related the wasps were to the queen. The new study shows conclusively that the determining factor is rank.

PHOTO: ANDREA ANGEL AND ROSS WANLESS

If it's always time to go, it may be time to talk with your doctor.

Frequent trips to the bathroom may be a symptom of benign prostatic hyperplasia (BPH), also known as enlarged prostate, a common and manageable condition that affects many men over age 50.

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Indicated to treat the signs and symptoms of BPH.

Important safety information: Do not take UROXATRAL if you have liver problems or if you are taking the antifungal drugs ketoconazole or itraconazole or HIV drugs like ritonavir. The most common side effects with UROXATRAL are dizziness, upper respiratory tract infection, headache, and tiredness. UROXATRAL can cause a sudden drop in blood pressure, especially when starting treatment. This may lead to fainting, dizziness, and lightheadedness. Do not drive, operate machinery, or do any dangerous activity until you know how UROXATRAL will affect you. This is especially important if you already have a problem with low blood pressure or take medicines to treat high blood pressure. Before taking UROXATRAL, tell your doctor if you have kidney problems. Also, tell your doctor if you or any family member(s) have or take medications for a rare heart condition known as congenital prolongation of the QT interval. BPH is not cancerous and does not lead to cancer, but men can have both BPH and prostate cancer.

sanofi aventis

Please see patient information on back.

www.uroxatral.com

Patient Information

UROXATRAL®
(Alfuzosin hydrochloride extended-release tablets)

Read the Patient Information that comes with UROXATRAL before you start using it and each time you get a refill. There may be new information. This leaflet does not take the place of talking with your doctor about your condition or your treatment. You and your doctor should talk about all your medicines, including UROXATRAL, now and at your regular checkups.

What is the most important information I should know about UROXATRAL?

UROXATRAL can cause:

- **a sudden drop in blood pressure, especially when you start treatment. This may lead ■ fainting, dizziness, or lightheadedness. Do not drive, operate machinery, or do any dangerous activities until you know how UROXATRAL affects you. This is especially important if you already have ■ problem with low blood pressure or take medicines to treat high blood pressure. If you begin to feel dizzy or lightheaded, lie down with your legs and feet up, and if your symptoms do not improve call your doctor.**

What is UROXATRAL?

UROXATRAL is a prescription medicine that is called an "alpha-blocker". UROXATRAL is used in adult men to treat the symptoms of benign prostatic hyperplasia (BPH). UROXATRAL may help to relax the muscles in the prostate and the bladder which may lessen the symptoms of BPH and improve urine flow.

Before prescribing UROXATRAL, your doctor may examine your prostate gland and do a blood test called a prostate specific antigen (PSA) test to check for prostate cancer. Prostate cancer and BPH can cause the same symptoms. Prostate cancer needs a different treatment.

UROXATRAL is not for use in women or children.

Some medicines called "alpha-blockers" are used to treat high blood pressure. UROXATRAL has not been studied for the treatment of high blood pressure.

Who should not take UROXATRAL?

Do not take UROXATRAL if you:

- have liver problems
- are taking antifungal drugs like ketoconazole or HIV drugs called protease inhibitors
- are already taking an alpha-blocker for either high blood pressure or prostate problems
- are a woman
- are a child under the age of 18
- are allergic to UROXATRAL. The active ingredient is alfuzosin hydrochloride. See the end of this leaflet for a complete list of ingredients in UROXATRAL.

Before taking UROXATRAL, tell your doctor:

- if you have liver problems
- if you have kidney problems
- if you or any family members have a rare heart condition known as congenital prolongation of the QT interval.
- about all the medicines you take, including prescription and non-prescription medicines, vitamins and herbal supplements. Some of your other medicines may affect the way you respond or react to UROXATRAL.
- if you have had low blood pressure, especially after taking another medicine. Signs of low blood pressure are fainting, dizziness, and lightheadedness.
- if you have a heart problem called angina (pain in your chest, jaw, or arm).

What you need to know while taking UROXATRAL (alfuzosin HCl) tablets

- If you have an eye surgery for cataract (clouding of the eye) planned, tell your ophthalmologist that you are using UROXATRAL or have previously been treated with an alpha-blocker.

How do I take UROXATRAL?

- Take UROXATRAL exactly as your doctor prescribes it.
- Take one UROXATRAL tablet after the same meal each day. UROXATRAL should be taken just after eating food. Do not take it on an empty stomach.
- Swallow the UROXATRAL tablet whole. Do not crush, split, or chew UROXATRAL tablets.
- If you take too much UROXATRAL call your local poison control center or emergency room right away.

What are the possible side effects of UROXATRAL?

The most common side effects with UROXATRAL are:

- dizziness
- headache
- tiredness

Call your doctor if you get any side effect that bothers you.

These are not all the side effects of UROXATRAL. For more information ask your doctor or pharmacist.

How do I store UROXATRAL?

Store UROXATRAL between 59°F and 86°F (15°C and 30°C).

Protect from light and moisture.

Keep UROXATRAL and all medicines out of the reach of children.

General information about UROXATRAL:

Medicines are sometimes prescribed for conditions that are not mentioned in patient information leaflets. Do not use UROXATRAL for a condition for which it was not prescribed. Do not give UROXATRAL to other people, even if they have the same symptoms you have. It may harm them.

This leaflet summarizes the most important information about UROXATRAL. If you would like more information, talk with your doctor. You can ask your doctor or pharmacist for information about UROXATRAL that is written for health professionals.

You may also visit our website at www.UROXATRAL.com or call 1-800-446-6267.

What are the ingredients of UROXATRAL?

Active Ingredient: alfuzosin hydrochloride

Inactive Ingredients: colloidal silicon dioxide (NF), ethylcellulose (NF), hydrogenated castor oil (NF), hydroxypropyl methylcellulose (USP), magnesium stearate (NF), mannitol (USP), microcrystalline cellulose (NF), povidone (USP), and yellow ferric oxide (NF).

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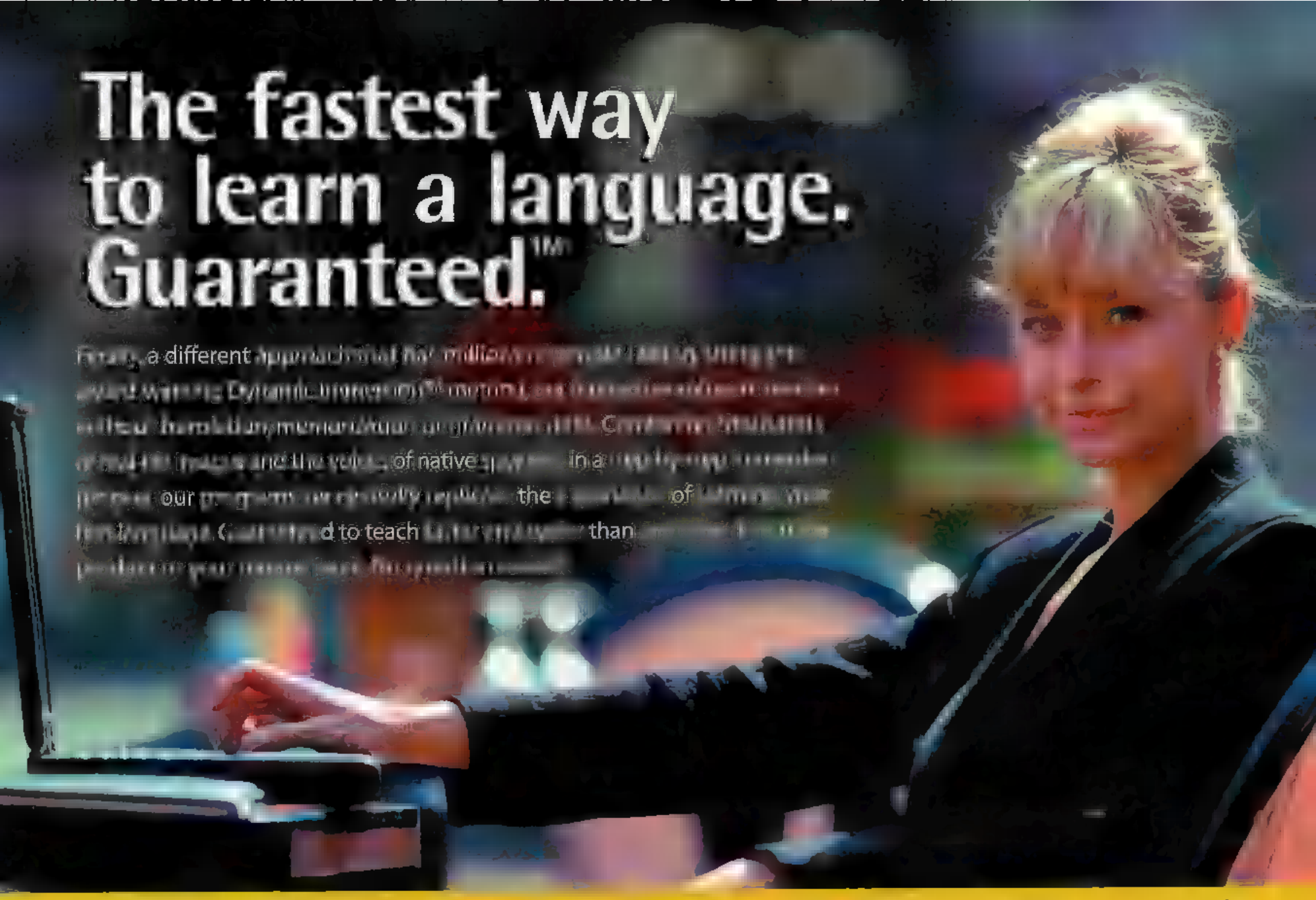

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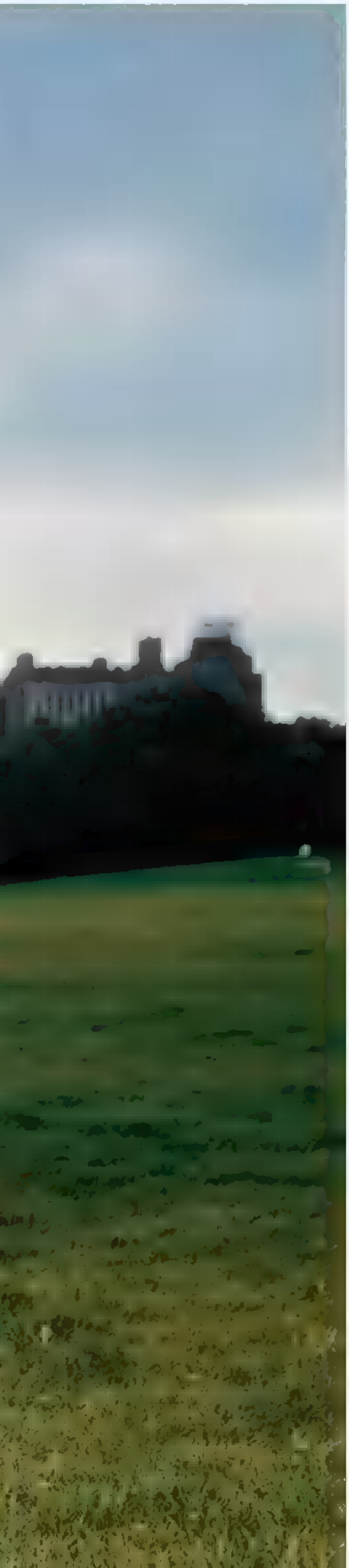

Christo and Jeanne-Claude Unwrapped

INTERVIEW BY CATHY NEWMAN

If all goes well, in the summer of 2010, artists Christo and Jeanne-Claude will suspend 962 panels of fabric, seven miles in length, over a 40-mile stretch of the Arkansas River in Colorado's Rocky Mountains. The woven cloth will shimmer like a newly minted dime, reflecting the sky above and the water below.

All may not go well. The weight of two federal and four state agencies, two counties, several towns, and an opposition group, Rags Over the Arkansas River, presses against the project known as "Over the River." Still, Christo and Jeanne-Claude have contended before with local, state, and federal bureaucracies, protest, and politicians. The eerie "Wrapped Reichstag, Berlin" (1995) took 24 years to be realized. Their most recent work, "The Gates, Central Park, New York City" (2005), 26 years. The shivery apparition of 178 wrapped trees in Switzerland (1998), 32 years. Controversy enriches their art. Controversy is part of the package. Actually, forget that word package. Although wrapping—a woman, a building, a bridge—propelled them to the world's attention, they no longer wrap (not so much as a Christmas gift, she says). They have moved on. These days, landscape is their canvas.

Before the interview, Jeanne-Claude lays out the rules of engagement: "Ask anything, but we do not talk of religion, politics, or other artists." The couple, born in 1935 on the same day and hour, live in a five-floor loft in New York's SoHo. She sits on a gray couch, lighting up the first of many Larks. Her hair, as red as a chili pepper, flares out like a magnetically charged aura. He, lanky and rumpled in torn jeans and gray fleece sweater, sits on the floor.

How and where did you meet?

Jeanne-Claude: In 1958, in Paris, a young Bulgarian refugee was creating his early works, like wrapped cans, which he was signing with his first name, Christo, but no one wanted to buy them. He had to survive. He washed cars in garages. He washed dishes in restaurants. But the third way was painting portraits of rich people. One day he appeared in the home of my mother and father to paint my mother's portrait. He painted her in classical style, then Impressionist, and by the time in cubist style, we were in love.
Christo: And I am still washing dishes, at home.

PHOTO: ANNIE LEIBOVITZ, CONTACT PRESS IMAGES

Jeanne-Claude and Christo at an exhibit of their work in Rostock, Germany. The sale of his preparatory drawings and early work finances their projects; they do not accept outside funding.

Although a collaborator for decades, Jeanne-Claude was not credited as joint artist until 1994. "Surrounded Islands" (1983), 11 islands in Florida's Biscayne Bay swaddled in flamingo pink fabric, was her idea. Christo makes the preparatory sketches. She cannot draw. She does, however, deal with the accountant. He does not.

How do you define yourselves and your work?

J: Labels are important mostly for bottles of wine—but if you need a label, environmental artist is OK. We work in urban and rural environments. Still, the media continue to call us wrapping artists.

C: We borrow space and create gentle disturbances for a few days. We inherit everything that is inherent in the space to become part of the work of art. All our projects are like fabulous expeditions. The story of each project is unique. Our projects have no precedent. And so . . .

J: . . . the hardest part of each project is to obtain the permits. Afterward, it's pleasure.

But isn't the concept the most difficult part?

J: No, the concept is easy. Any idiot can have a good idea. What is hard is to do it.

"Over the River" began as an image: fabric suspended over water. But fabric over water where? Christo and Jeanne-Claude spent three summers covering 14,000 miles in six states, evaluating 89 rivers before narrowing the choice to six. They selected the Arkansas because its banks were high enough to suspend the fabric panels without impeding the thousands of river rafters expected to course under the canopy. As he talks, Christo's voice accelerates, delivering a litany of statistics. "Running Fence," for example—an 18-foot-high, 24.5-mile-long white nylon fabric fence that snaked through ranch country north of San Francisco—took 42 months, required 59 participating ranchers, 18 public hearings, three sessions in California's superior courts, and a 450-page environmental impact report, not to mention 240,000 square yards of fabric, 2,050 steel poles, 14,000 earth anchors and . . . well, you get the idea.

C: Each project has its own character, its personality; you cannot know in advance. So much writing. So much more things. These projects are so complicated . . .

J: . . . and simple at the same time.

C: Understand, we are not masochists: We don't say, "Please give us problems to get the permissions." No. We are working with a lot of elements. And we never do the same thing again. We will never

PHOTO: JENS KOEHLER, AFP/GETTY IMAGES

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build another "Gates," we will never build another "Running Fence," we will never surround islands. Permits are built on precedent, but there is no precedent for our work, so this is why we go to a huge amount of explanation.

So where do you start? What's the first step?

C: Themostimportantthingisto . . .
J: Wait! Wait! I didn't understand ■ thing you said. Speak SLOWLY.

Throughout the conversation the two run over each other's sentences; words collide, correct, contradict, and are compounded by a thick Bulgarian accent (his) and a French inflection (hers). More often, it's Jeanne-Claude putting a hand on his arm, interjecting: "Let me explain." He talks in broad gestures, arms waving. She—the counterbalance and center of gravity to his centrifugal force—remains contained, cool.

C: I said, "The . . . most . . . important . . . thing . . . is . . . to . . . find . . . out . . . who . . . owns the land." In this case ["Over the River"], the Bureau of Land Management manages it.

"Over the River," like all their works, is a parry and thrust of anxieties, opposition, and—on the artists' side—explanation, reassurance, and provisions for mitigation.

Tell me some of the concerns this project has evoked and how you have responded to them.

C: For example, a resident says if there is a huge traffic jam and a woman is pregnant, the ambulance cannot take her to the hospital. So we arrange standby helicopters to fly people to the hospital.
J: A ranger shows us a spot along the river and says: "At this place every year someone drowns. We have to be able to rescue." Fine. We don't put fabric there. We skip. The ranger shows us the bighorn sheep's favorite water place. Fine. We skip.
C: If there is a bridge . . .
J: . . . we skip.
C: There are the eagles, the trout . . .
J: There are no problems. We have the solutions.
C: They are worried where people will sleep. We try to explain, it is not a rock concert. It is a work of art, and our public is different. They imagine people bringing tents. But art collectors don't do that. They will come from Aspen. They will go back to Aspen.

"Over the River" has caused dissension in families as well.

C: A man comes to me screaming, "I never in my life have heard

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taste, headache, and dizziness.

on the next

Lunesta℠ (eszopiclone)℞

1, 2 AND 3 MG TABLETS

Please read this summary of information about LUNESTA before you talk to your doctor or start using LUNESTA. It is not meant to take the place of your doctor's instructions. If you have any questions about LUNESTA tablets, be sure to ask your doctor or pharmacist.

LUNESTA is used to treat different types of sleep problems, such as difficulty in falling asleep, difficulty in maintaining sleep during the night, and waking up too early in the morning. Most people with insomnia have more than one of these problems. You should take LUNESTA immediately before going to bed because of the risk of falling.

LUNESTA belongs to a group of medicines known as "hypnotics" or, simply, sleep medicines. There are many different sleep medicines available to help people sleep better. Insomnia is often transient and intermittent. It usually requires treatment for only a short time, usually 7 to 10 days up to 2 weeks. If your insomnia does not improve after 7 to 10 days of treatment, see your doctor, because it may be a sign of an underlying condition. Some people have chronic sleep problems that may require more prolonged use of sleep medicine. However, you should not use these medicines for long periods without talking with your doctor about the risks and benefits of prolonged use.

Side Effects

All medicines have side effects. The most common side effects of sleep medicines are:

- Drowsiness
- Dizziness
- Lightheadedness
- Difficulty with coordination

Sleep medicines can make you sleepy during the day. How drowsy you feel depends upon how your body reacts to the medicine, which sleep medicine you are taking, and how large a dose your doctor has prescribed. Daytime drowsiness is best avoided by taking the lowest dose possible that will still help you sleep at night. Your doctor will work with you to find the dose of LUNESTA that is best for you. Some people taking LUNESTA have reported next-day sleepiness.

To manage these side effects while you are taking this medicine:

- When you first start taking LUNESTA or any other sleep medicine, until you know whether the medicine will still have some effect on you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
- Do not drink alcohol when you are taking LUNESTA or any sleep medicine. Alcohol can increase the side effects of LUNESTA or any other sleep medicine.
- Do not take any other medicines without asking your doctor first. This includes medicines you can buy without a prescription. Some medicines can cause drowsiness and are best avoided while taking LUNESTA.
- Always take the exact dose of LUNESTA prescribed by your doctor. Never change your dose without talking to your doctor first.

Special Concerns

There are some special problems that may occur while taking sleep medicines.

Memory Problems

Sleep medicines may cause a special type of memory loss or "amnesia." When this occurs, a person may not remember what has happened for several hours after taking the medicine. This is usually not a problem since most people fall asleep after taking the medicine. Memory loss can be a problem, however, when sleep medicines are taken while traveling, such as during an airplane flight and the person wakes up before the effect of the medicine is gone. This has been called "traveler's amnesia." Memory problems have been reported rarely by patients taking LUNESTA in clinical studies. In most cases, memory problems can be avoided if you take LUNESTA only when you are able to get a full night of sleep before you need to be active again. Be sure to talk to your doctor if you think you are having memory problems.

Tolerance

When sleep medicines are used every night for more than a few weeks, they may lose their effectiveness in helping you sleep. This is known as "tolerance." Development of tolerance to LUNESTA was not observed in a clinical study of 6 months' duration. Insomnia is often transient and intermittent, and prolonged use of sleep medicines is generally not necessary. Some people, though, have chronic sleep problems that may require more prolonged use of sleep medicine. If your sleep problems continue, consult your doctor, who will determine whether other measures are needed to overcome your sleep problems.

Dependence

Sleep medicines can cause dependence in some people, especially when these medicines are used regularly for longer than a few weeks or at high doses. Dependence is the need to continue taking a medicine because stopping it is unpleasant. When people develop dependence, stopping the medicine suddenly may cause unpleasant symptoms (see *Withdrawal* below). They may find they have to keep taking the medicine either at the prescribed dose or at increasing doses just to avoid withdrawal symptoms.

All people taking sleep medicines have some risk of becoming dependent on the medicine. However, people who have been dependent on alcohol or other drugs in the past may have a higher chance of becoming addicted to sleep medicines. This possibility must be considered before using these medicines for more than a few weeks. If you have been addicted to alcohol or drugs in the past, it is important to tell your doctor before starting LUNESTA or any sleep medicine.

Withdrawal

Withdrawal symptoms may occur when sleep medicines are stopped suddenly after being used daily for a long time. In some cases, these symptoms can occur even if the medicine has been used for only a week or two. In mild cases, withdrawal symptoms may include unpleasant feelings. In more severe cases, abdominal and muscle cramps, vomiting, sweating, shakiness, and, rarely, seizures may occur. These more severe withdrawal symptoms are very uncommon. Although withdrawal symptoms have not been observed in the relatively limited controlled trials experience with LUNESTA, there is, nevertheless, the risk of such events in association with the use of any sleep medicine.

Another problem that may occur when sleep medicines are stopped is known as "rebound insomnia." This means that a person may have more trouble sleeping the first few nights after the medicine is stopped than before starting the medicine. If you should experience rebound insomnia, do not get discouraged. This problem usually goes away on its own after a or 2 nights.

If you have been taking LUNESTA or any other sleep medicine for more than 1 or 2 weeks, do not stop taking it on your own. Always follow your doctor's directions.

Changes In Behavior And Thinking

Some people using sleep medicines have experienced unusual changes in their thinking and/or behavior. These effects are not common. However, they have included:

- More outgoing or aggressive behavior than normal
- Confusion
- Strange behavior
- Agitation
- Hallucinations
- Worsening of depression
- Suicidal thoughts

How often these effects occur depends on several factors, such as a person's general health, the use of other medicines, and which sleep medicine is being used. Clinical experience with LUNESTA suggests that it is rarely associated with these behavior changes.

It is also important to realize it is rarely clear whether these behavior changes are caused by the medicine, are caused by an illness, or have occurred on their own. In fact, sleep problems that do not

improve may be due to illnesses that were present before the medicine was used. If you or your family notice any changes in your behavior, or if you have any unusual or disturbing thoughts, call your doctor immediately.

Pregnancy And Breastfeeding

Sleep medicines may cause sedation or other potential effects in the unborn baby when used during the last weeks of pregnancy. Be sure to tell your doctor if you ▪▪ pregnant, if you are planning to become pregnant, or if you become pregnant while taking LUNESTA.

In addition, a very small amount of LUNESTA may be present in breast milk after use of the medication. The effects of very small amounts of LUNESTA on an infant are not known; therefore, as with all other prescription sleep medicines, it ▪ recommended that you not take LUNESTA if you are breastfeeding ▪ baby.

Safe Use Of Sleep Medicines

To ensure the safe and effective use of LUNESTA or any other sleep medicine, you should observe the following cautions:

1. LUNESTA is ▪ prescription medicine and should be used ONLY as directed by your doctor. Follow your doctor's instructions about how to take, when to take, and how long to take LUNESTA.
2. Never use LUNESTA or any other sleep medicine for longer than directed by your doctor.
3. If you notice any unusual and/or disturbing thoughts or behavior during treatment with LUNESTA or any other sleep medicine, contact your doctor.
4. Tell your doctor about any medicines you may be taking, including medicines you may buy without a prescription and herbal preparations. You should also tell your doctor if you drink alcohol. DO NOT use alcohol while taking LUNESTA ▪▪ any other sleep medicine.
5. Do not take LUNESTA unless you are able to get 8 or more hours of sleep before you must be active again.
6. Do not increase the prescribed dose of LUNESTA or any other sleep medicine unless instructed by your doctor.
7. When you first start taking LUNESTA or any other sleep medicine, until you know whether the medicine will still have some effect on you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
8. Be aware that you may have more sleeping problems the first night or two after stopping any sleep medicine.
9. Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, if you become pregnant, or if you are breastfeeding a baby while taking LUNESTA.
10. As with all prescription medicines, never share LUNESTA or any other sleep medicine with anyone else. Always store LUNESTA or any other sleep medicine in the original container and out of reach of children.
11. ▪▪ sure to tell your doctor if you suffer from depression.
12. LUNESTA works very quickly. You should only take LUNESTA immediately before going to bed.
13. For LUNESTA to work best, you should not take it with or immediately after ▪ high-fat, heavy meal.
14. Some people, such as older adults (i.e., ages 65 and over) and people with liver disease, should start with the lower dose (1 mg) of LUNESTA. Your doctor may choose to start therapy at 2 mg. In general, adults under age 65 should be treated with 2 or 3 mg.
15. Each tablet is a single dose; do not crush or break the tablet.

Note: This summary provides important information about LUNESTA. If you would like more information, ask your doctor or pharmacist ▪▪ let you read the Prescribing Information and then discuss ▪ with him or her.

Rx only

SEPRACOR

In February 2005, the artists and their team unfurled "Gates" in Central Park. The 7,503 saffron-colored fabric panels stayed up for 16 days before being dismantled.

such things at the dinner table. I am fighting with my son." The son wants it. The father does not.

J: What they don't realize is that for the first time they are talking about art. But some say it is not art. They say the river is art. This we have everywhere. We had this with "Gates." They said: "Central Park is the 'Mona Lisa' of landscape. Do not desecrate it."

So opponents compare your projects to painting a mustache on the "Mona Lisa"? What are people really afraid of?

J: People are afraid of the new. They are afraid of what they do not understand. You see it in every science fiction film. There is a flying saucer. The little green man comes out. What do we do? We shoot. Always. We don't talk. We don't try to explain. We shoot.

C: Also, we are not very loved by the professionals. Some museums are not very kind to us because we are outside the art system.

J: You are being too intelligent. I call it jealousy.

Christo and Jeanne-Claude have spent 2.5 million dollars on "Over the River" so far, with no permits in sight. They do not accept any public funding or corporate sponsorship; they finance their work through the sale of his preparatory drawings and early work. They borrow—banks happily accept his art as collateral. Preparatory works sell in the five- and six-figure range; early pieces can go for more. And they own thousands of his pieces, stored in three warehouses in Europe and New York.

And the final cost of "Over the River" will be?

C: Ah, that is another story.

J: It will cost what it will cost.

Plans call for "Over the River" to remain for 14 days before being dismantled and the materials recycled. Likewise, the Reichstag stayed wrapped for 14 days, then the German government, which initially opposed the project, asked for an extension. The artists refused. It was unwrapped as scheduled.

Why only 14 days? Isn't art supposed to be lasting and eternal?

J: Artists of the past have created works in bronze, in marble, in fresco, in oil, even with televisions; they have created works that have been mythological or religious or portraits of landscapes. But there is one quality they have never used, and that is the quality of love and tenderness that we human beings have for what does not last. We have love and tenderness for childhood and for our own lives because we know they will not last. And so we wish our work of art to be once in a lifetime and never again.

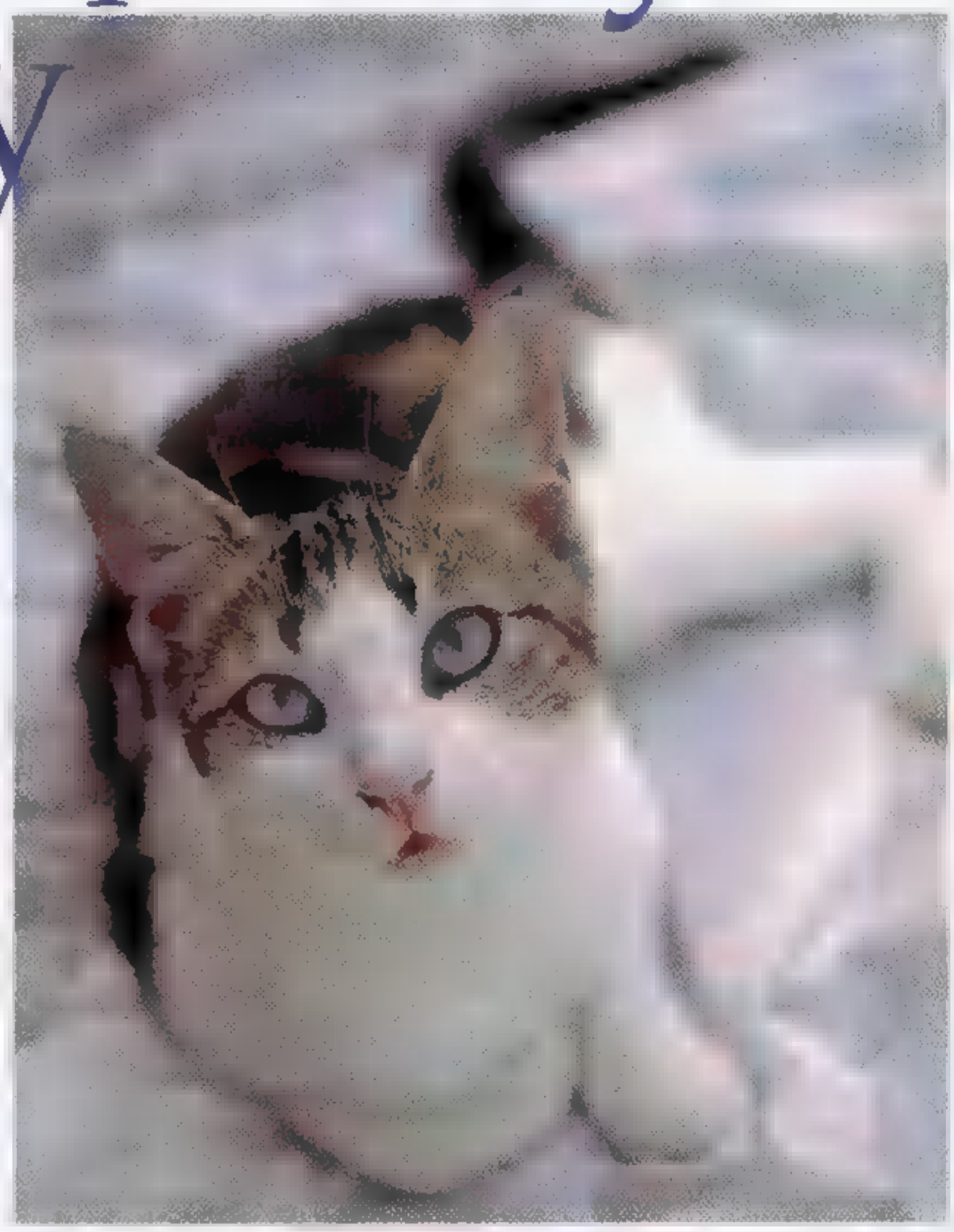
PHOTO: ALEX WEBB, MAGNUM PHOTOS

WE'D DEVELOP FORMULA 410,

BUT IT WOULD BE ILLEGAL IN 12 STATES.

GOOD GROOMING

How to Keep Kitty Happy



Your cat's attitude is one of independence and self-reliance, but you know it's all for show. Even though you let your feline friend strut around like she owns the place, the truth is she needs you. Her happiness and health rest in your hands — and that's a responsibility cat owners take seriously. There are a few things you can do to keep your cat purring.

BRUSHING

How often: When cats groom themselves, they digest a lot of hair, and this can lead to hairballs. Long-haired cats need more grooming and should be brushed daily to prevent matting, while short-haired cats can be brushed just two times a week.

Make it easy! Brushing your cat should be enjoyable for both of you. Until she learns to like it, keep the sessions short, stopping if she seems agitated, and then try again later.

CLIPPING

How often: If your cat wears down her nails on hard outdoor surfaces, she will need less clipping than an indoor cat. But in general, a cat's nails need clipping every two weeks.

Make it easy! Get your cat used to her home pedicures by touching and massaging her paws even when you don't have the clippers in your hands. That way, she won't protest when it's time for a clipping.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Tilex
Mold & Mildew
THE MOLD KILLER.

Brita filters out what weighs you down.

BRITA

All our projects are absolutely irrational with no justification to exist. They are created because Jeanne-Claude and I have this unstoppable urge to create. They are made for us first. Not the public.

Christo and Jeanne-Claude are shown six photographs to be published in NATIONAL GEOGRAPHIC for a story on national parks. The images show the majesty of mountains, rivers, and canyons. There is no running fence, no fabric over river, no wrapped trees in sight. Just pure, spectacular landscape. How, they are asked, can your work improve on this?

C: But our work is not about improvement. It is interpretation. Claude Monet painted the Cathedral of Rouen. One of his paintings is pink, one blue, one yellow. He never says the cathedral is not beautiful. He makes an interpretation of the Cathedral of Rouen. This is art.

J: A young writer tried to argue that we didn't even have to realize the project. We could just do the sketches and create a virtual reality. I said, "Young man, do you have a girlfriend? Have you ever made love to her? Do you make love to a picture or to her?"

The question remains: Why? Why suspend seven miles of fabric over a river? Why surround 11 islands with 722,200 square yards of pink polypropylene? Why hang 7,503 saffron yellow panels in Central Park? Why?

C: All our projects are absolutely irrational with no justification to exist. Nobody needs a running fence or surrounded islands. They are created because Jeanne-Claude and I have this unstoppable urge to create. They are made for us first. Not the public. Artists have a huge white canvas and an indestructible urge to fill it with color. There is no reason. Of course, if Mr. Smith likes the canvas, it's good, but the true artist doesn't make it for Mr. Smith. It is so fragile, so human, so marvelous. The reason we don't like the projects to stay is no one can charge for tickets, no one can buy this project. It is freedom. Freedom is the enemy of possession and possession is permanence. These projects are once in a lifetime. It is not like the bombardment of pictures of repetitious things, the globalization of the same imagery—the blockbuster exhibition, the big Olympic Games, the same thing over and over. Humans, unique themselves, like to be in the presence of the unique. When a project is realized, the joy, the beauty makes for total awe and everything else looks trivial and banal.

So far, 19 of your projects have been completed; 37 have failed to be realized. You still have many obstacles to overcome before "Over the River" can go forward. How long will you work to see this project come to life?

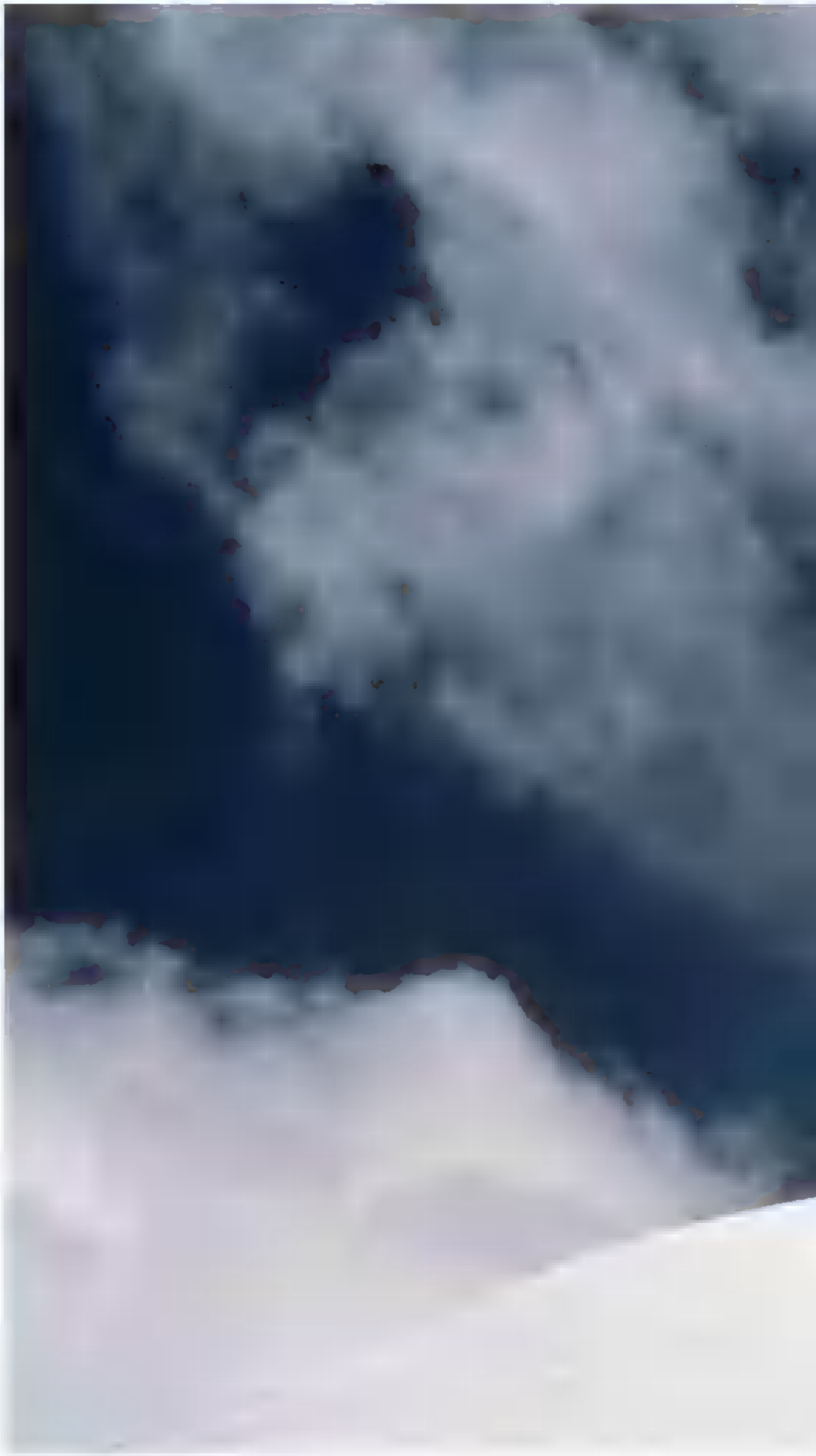
J: Until our teeth fall out. □

How Reinhold Messner, the world's greatest mountaineer, willed himself to shatter the limits.

Murdering the Impossible

By Caroline Alexander

Photographs by Vincent J. Musi



1980 SOLO SUMMIT OF MOUNT EVEREST

"If some people are telling you they had their climax on Mount Everest, they lied," Messner said. "It is an awful place." Then why risk everything to get there? "Without the possibility of death," he said, "adventure is not possible."

REINHOLD MESSNER ARCHIVES

Beyond the walls of the 16th-century fortress, in northern Italy, the Dolomite range rose burnished and glowing in the late afternoon light. Within the walls, **Reinhold Messner, the world's greatest mountaineer,** was building a mountain. At his energetic direction, a backhoe

lumbered back and forth in the dusty courtyard, heaving slabs of rock and depositing them in an artful pyramid that by the end of the exercise had formed a small mountain.

"This is Kailas, Holy Mountain," Reinhold said, while the backhoe filled the air with golden dust. He was relishing the scene—the whole scene; not just the satisfaction of seeing Tibet's most holy mountain assembled in miniature under his supervision but also, I suspected, the roar and rumble and chaos and dust and magnificent improbability of the undertaking. The Kailas installation is only one of the many features, fanciful and inspired, that will fill his latest Messner Mountain Museum, this one dedicated to the theme of "When Men Meet Mountains."

Reinhold Messner is well into what he has designated Stage Six of his already remarkable life, without, it would seem, a backward glance for Stage One, when he was one of the world's elite rock climbers, or Stage Two, when he was unquestionably the world's greatest high-altitude mountaineer. Today, at 62, he is instantly recognizable from the multitude of publicity photographs taken over the past three decades—lean and fit and sporting an even longer mane of waving hair, now threaded with silver, than he did when younger. His features tend to alternate between two characteristic expressions: The first, a look of fierce intensity, which, combined with beetling eyebrows and flowing beard and hair, give him an air of Zeus-like authority. It was with this expression that he moved his mountain. The second is his trademark smile—a reflexive baring of his very white, even teeth behind his beard—which gleams on friend and foe without distinction, like the smile of a crocodile. It was the crocodile smile he was baring now, as he envisioned the climactic moment of opening night of the Messner museum: A violent explosion, simulating a volcanic eruption, was to rend the night from inside the castle walls. "There should be a lot of flames and smoke," he said, again with relish. "It should be at night so that the whole of Bolzano can see." He paused to savor the image of a fireworks blast that would appear to viewers as a catastrophic blowup. "Then my friends will say, 'It is a pity,' and my enemies will say, 'Good, finally, at last!' "

To non-climbers it may be difficult to convey the extent and grandeur of Reinhold Messner's accomplishments. Here's a start: His ascent, with longtime partner Peter Habeler, of Hidden Peak, the 26,470-foot (8,068-meter) summit of Gasherbrum I, one of the giants of the Himalaya, without any of the paraphernalia of traditional high-altitude climbing—porters, camps, fixed ropes, and oxygen—was hailed as forging a whole

new standard of mountaineering. But that was back in 1975, before Messner and Habeler went on to climb Mount Everest without oxygen, a feat that took climbing to the absolute limit. That, in turn, was in May of 1978—three months before Messner climbed Nanga Parbat, the ninth highest mountain on Earth, solo—a feat heralded as one of the most daring in mountaineering. That, however, was two years before he climbed Mount Everest without oxygen, equipped with a single small rucksack—and alone.

"It is very difficult to calibrate high-altitude climbing," said Hans Kammerlander, who has climbed seven of the world's fourteen 8,000-meter mountains with Messner. "There is no referee, there is no stopwatch. There were others—Buhl, Herzog, Forrer," he said, running through the names of climbing greats. "They did more solo climbs. But Reinhold had so many new ideas—he found new ways, new techniques. He imagined them, and then he put them into practice. So, all around, yes, he does deserve the title of being the greatest mountaineer in history."

Messner's contribution to his profession is not only a list of astonishing feats but also the unrelenting philosophy that lay behind them. "I'm only interested in our experiences and not in the mountains—I'm not a naturalist," he told me. "I'm interested in what's going on in the human beings. . . . William Blake wrote a line, when men and mountains are meeting, big things are happening," he said, paraphrasing a favorite quote from the 18th-century poet, and the philosophy behind his new museum. "If you have a highway on Everest, you don't meet the mountain. If everything is prepared, and you have a guide who is responsible for your security, you cannot meet the mountain. Meeting mountains is only possible if you . . . are out there in self-sufficiency."

In an essay he wrote when he was only 27, he decried the siege tactics that allowed even an unskilled climber to conquer a mountain bolt by bolt, issuing a plea for both the mountain that cannot "defend itself" and for the climber, who was being cheated of the opportunity to test the limits of his courage and skill. Titled "The Murder of the Impossible," the essay, now considered a minor classic, argued that the wielders of expansion bolts and pegs "thoughtlessly killed the ideal of the impossible." Messner's characteristic minimalism—he is adamant he has never put an expansion bolt in a face of rock, as he has never used bottled oxygen—was, therefore, a brash demonstration that the principles he preached could be put to spectacular practice. His landmark high-altitude alpine-style climbs liberated both the individual climber, by showing alternatives to the hugely encumbered and expensive

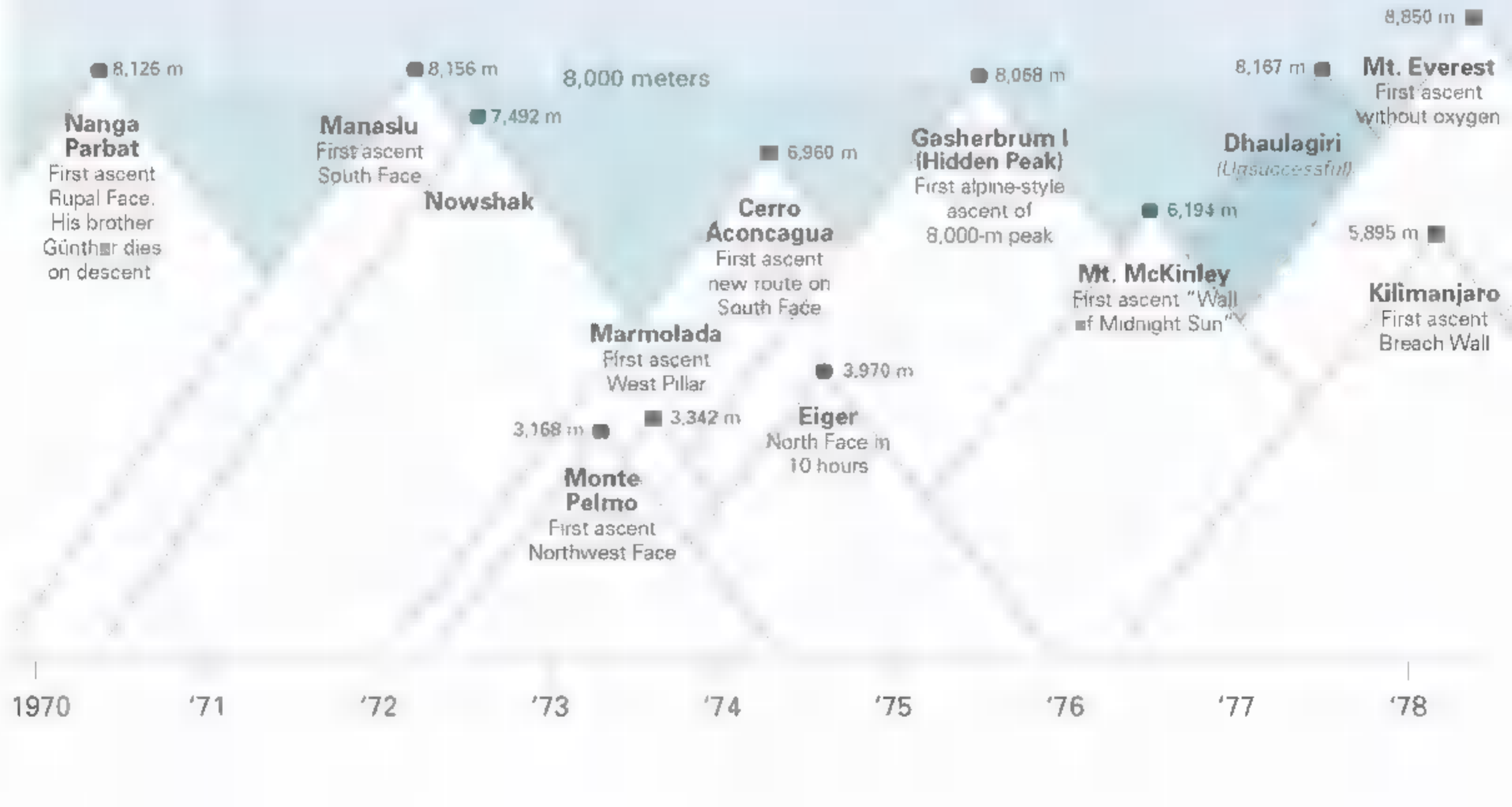
classic expeditions, as well as the mountains themselves. The irony, of course, was that it was Messner who, by these very achievements, murdered and laid in the dust all traditional notions of what constituted "the impossible."

Thanks to the stream of books that followed his accomplishments, and aided by dark good looks that rendered him promotable, Messner achieved a celebrity status that extended far beyond subscribers to *Alpinist* and *Gripped*. In Europe, where frequent appearances on television have kept him in the public eye, as well as afforded him a platform for his often blunt outspokenness, he continues to evoke strong emotions, received by admirers with the adoration bestowed on rock stars and by his detractors with resentful charges of self-promotion. He receives both with equal enthusiasm. "Obstacles energize me," he told me. Tirelessly confrontational, he is famous for outbursts of towering rage. "I became so angry that I yelled in a way that the windows there, they were shivering," he told me with satisfaction of an encounter with a local foe. One could say fairly that Reinhold was conditioned from youth by the same phenomena that energize him now: obstacles, risk, and high-adrenaline rage.

Reinhold was born and raised in St. Peter's, a hamlet in the Villnöss Valley, in northern Italy's South Tirol, a place he still claims is the "most beautiful in the world." Wholly defining the valley, the ethereal Geislerspitzen range rises above the Alpine meadows in bare rock pinnacles and spires, as improbably striking as the turrets of a distant fairy-tale kingdom. "The climbing had to do with two facts," Reinhold said. "My father was a climber—but not an extreme climber—so as children we heard about this. Secondly, we had no football place in the valley . . . we had no swimming pool—I'm still not able to swim. And the only possibility to do something to express ourselves was to go on the rocks. So we learned very early." Reinhold was five years old when, led by his father, he made his first summit, toiling some 3,000 feet up a peak in the Geislerspitzen; by 13 he had overtaken

Messner's vertical achievements

Reinhold Messner, a leading rock climber in the Alps in the 1960s, became the first to climb all of the world's fourteen 8,000-meter mountains. He also pioneered new routes up other challenging peaks.



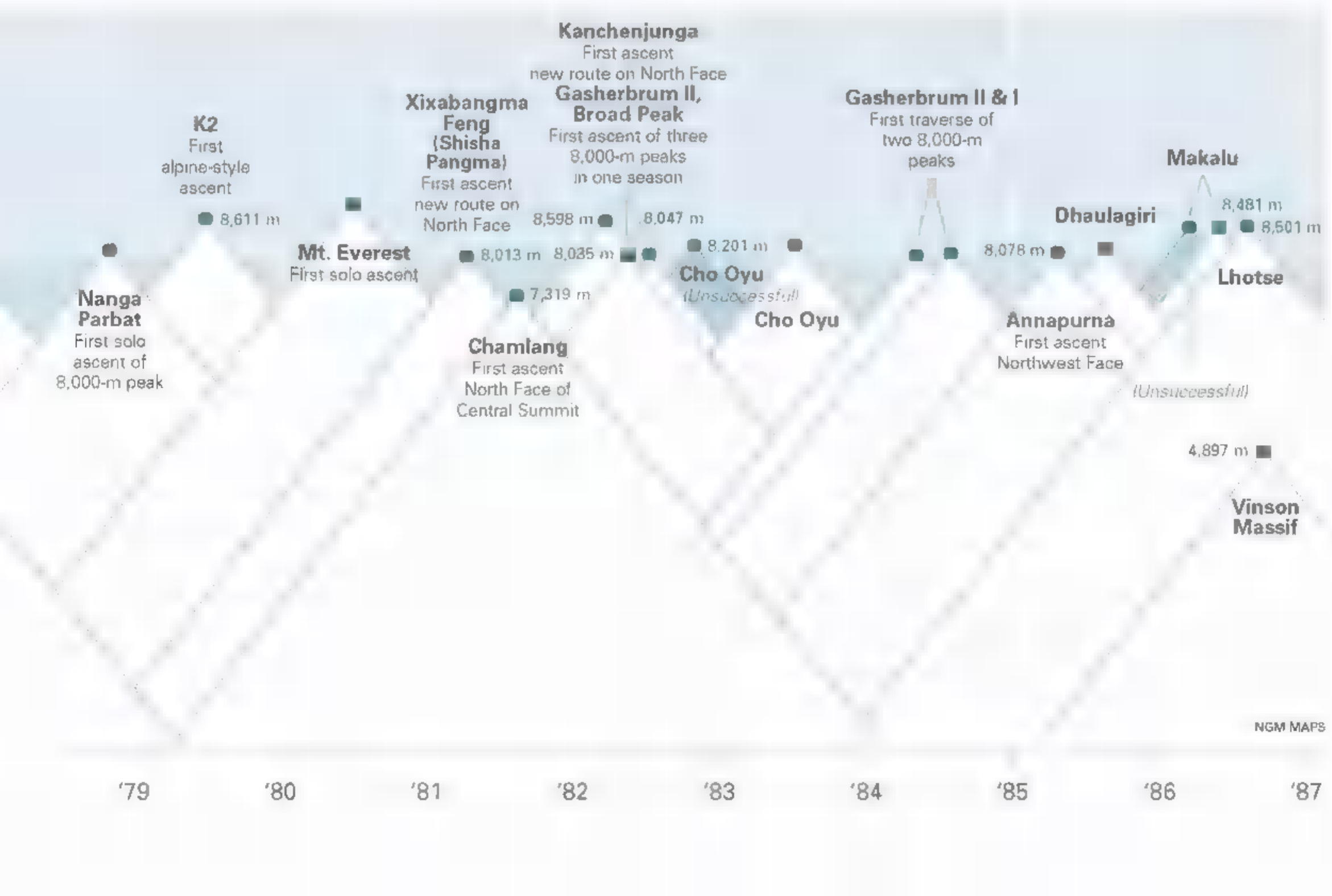
his father and claimed the sport as his own.

South Tirol has a vexed political history, its identity split between Italy and Austria. Even today its valleys and towns carry both Italian and German names, and most families grow up as the Messners did, Italian citizens but German speaking. Reinhold's mother, Maria Troi, was better educated than was then traditional for girls. "My mother would give us the freedom to do what we had the feeling we had to do," said Reinhold, an attitude unusual in the postwar valleys, where lives were directed by practical concerns of earning a living. Repeatedly, people described her as a calming, gentle force in a turbulent family.

Josef Messner, the family patriarch, was a complicated man, and his relationship with his sons was similarly complicated. As a boy, Josef had been a promising student, but family circumstances prevented him from pursuing higher education. He became a schoolteacher and married Reinhold's mother, moving into an upper-story flat in a house her father owned. The growing family lived here, with a new child born almost every other year. Their flat, where the only heat came from the kitchen's woodstove, was above a butcher's shop, and the animals were slaughtered in a shed beside the house. As did many in the valley, the Messners grew vegetables and kept chickens, which the young boys were taught to kill. While the single sister, Waltraud, helped the mother in the house, the boys were kept busy with outside chores, hauling wood and stones, each looking after his immediately younger brother. Reinhold's special charge was his brother Günther. In the Messner home, as in the rugged Tirol in general, self-sufficiency was a paramount virtue.

"The father was a devoted Catholic, but in a Calvinist manner," said Reinhold's former wife, Ursula Demeter, known as Uschi, who retains warm ties with Reinhold and his family. The mother was "quiet, peaceful, fatalistic—God had given her her station. But for the father, if you did not make money, if you did not succeed, God had turned from you."

Josef Messner's life was further complicated by his chosen politics. "In '38, Hitler and Mussolini came together, and they decided the South



Tiroleans should take a chance to vote," Reinhold told me. "Who is voting for Italy stays in South Tirol; who is voting for Germany, for the Führer, he can leave, and he will get the same amount of land somewhere in Germany. And my father was one of the organizers of this option . . . in which 86 percent"—he leaned forward for emphasis—"of the South Tiroleans decided they would leave their homeland to go somewhere with the Nazis." He shook his head. "It is incredible." The war put an end to all such options. By voluntarily becoming a Nazi, Josef Messner had staked his hopes on a German future; ironically, his wartime duties had been to serve as an Italian translator. At war's end, he returned to his wife's house in the narrow valley and set about raising his family of nine children with their resolutely Teutonic names—Werner, Reinhold, Siegfried, Waltraud—on what was now a headmaster's salary.

"My father was an anxious man," said Hansjörg Messner, one of Reinhold's younger brothers and a psychotherapist in London. "His anxiety made him a strict man. He wasn't austere; he was a strict man in given moments, so his strictness, or even perhaps his violence at times, was, I think, a basic reaction to his anxiety." The flashes of violence took several forms—beatings, not uncommon in rural communities of that era, and verbal tirades. "My father had the ability not just to shout but to humiliate," Hansjörg said. When the young Reinhold failed his school exams because he had spent less time studying than climbing, the father had poured out the full violence of his scorn. "I remember Reinhold sitting at the wooden table in the kitchen, holding his head and just crying and crying," Hansjörg said. At that moment the father could triumph; he had been proven irrefutably right. Repeatedly, vehemently, over the years he had been telling his stubborn son that a life doing what he loved and did best—the life of a climber—was impossible.

"In the family, I told you, there was only one chance," Reinhold said. "To break, to be broken, or to be stronger than the father."

By the time Reinhold was 13 and Günther 11, they had formed an unassailable climbing partnership. Both precociously strong and talented, they differed sharply in personality. Reinhold was outspoken and confrontational—public—according to his brother Hubert Messner, head of neonatology at Bolzano Hospital, while Günther was closed. "Reinhold started to do everything he wanted to do. Günther was not this way," Hubert said. "Günther, because he was influenced more by our father—I think that was the big problem. He was not able to say, 'I don't like it, I don't do it.'"

From the rock towers of the Geislerspitzen, Reinhold and Günther moved to other Dolomite peaks, then farther afield onto classic ascents in the western Alps. In the Dolomites, they mastered freestyle rock climbing, but in the Alps they gained experience of mixed terrain and pure ice. When Reinhold was 20 and Günther 18, they were in a position to measure themselves against some of Europe's most experienced climbers. "When I had a chance to climb with them, or go on a similar route where a famous climber had been, I was only looking and learning," Reinhold said, and paused. "For a few years. And I would say at 20, 23, we understood, there is nobody who can climb what we are climbing." Although the brothers continued as partners, Reinhold had taken to lightning-strike solo dashes to the summits, traveling as light and fast as possible. "Reinhold's solo climbs in the Dolomites from '65 to after '70 count as some of his best," said Hans Kammerlander, who is also from the South Tirol. "These experiences are often overlooked."

As the brothers racked up noteworthy ascents, what Hansjörg calls Reinhold's "triumphalism" became more pronounced. "There was a place in the village where we could go to watch a television," Hansjörg said. "And we used to watch the fights of Cassius Clay. You know how Clay used to call his fights: 'I'll take him in round six!' That's when Reinhold began to call his climbs. 'The Eiger face in ten hours!'"

Much of Reinhold's style—traveling light and quickly—depended on his uncanny speed. Just how fast he was capable of moving he would

dramatically demonstrate many times over in the years ahead. One example: On an expedition in 1979 to Ama Dablam in Nepal, Reinhold and his friend Oswald Oelz conducted a spectacular rescue of Peter Hillary, son of the great explorer, and two companions. "Reinhold covered that ground that the New Zealand climbers had taken two and a half days to climb in six hours," recalled Nena Holguín, a witness of the rescue. "I mean he moved like lightning speed across the snow. You know how deer are light-footed—he would seem to spring; it seemed like he hardly touched the ground."

After Reinhold and Günther completed their schooling, they began to train, grudgingly, for professions, Reinhold as an architect at Padua University, Günther to work in a bank. But their real education continued on the rocks. "I trained also to stay days out—days and days without food," Reinhold said. "We went into the mountains without taking food with us; we had to carry it, so we learned to do without it." They also learned, as Reinhold put it, "to handle situations," or retain emotional equilibrium.

"I think that courage is only the other half of fear," he said. "Only because I am afraid, I need courage . . . If I am well-prepared, and if I'm living a long time in my visions, in my fantasy, with my challenge—before doing it, I'm living with it, I'm dreaming about it, planning, preparing, training. So when I start to climb—especially when I'm on a big wall, whatever difficulties—I am so concentrated that there is nothing else existing; there's only a few meters of wall where I am hanging and climbing; and in this concentration, everything seems quite logical. There is no danger anymore. The danger is gone . . . But the concentration is absolute."

By 1969, Reinhold had obtained his diploma in architecture and was teaching mathematics in a local secondary school, an occupation he had chosen solely because it allowed him to climb. Then out of the blue came an invitation to join an expedition in the Himalaya. It was to be a turning point. "I see Reinhold in two phases, you see," Hansjörg said, carefully. "I see him before Nanga Parbat and after Nanga Parbat."

Reinhold was five years old when, led by his father, he made his first summit. Repeatedly, vehemently, his father told him the life of a climber was impossible. "In the family, there was only one chance—to break, to be broken, or to be stronger than the father."

1958 REINHOLD, SECOND [redacted] LEFT, WITH [redacted] IN SOUTH TIROL

REINHOLD MESSNER ARCHIVES. PHOTO BY JOSEF MESSNER

"So when I start to climb, I am so concentrated that there is nothing else existing. In this concentration, everything seems quite logical. The danger is gone. But the concentration is absolute."

1975 LHOTSE

Climbers speak of a mountain's "line," the route up its face that unlocks the summit. The line of Reinhold Messner's life, that line that unlocks and defines him, is unquestionably the 1970 Austro-German Sigi Löw Memorial Expedition to Nanga Parbat. Rising in northern Pakistan, Nanga Parbat is one of the world's eight-thousanders, the 14 mountains standing above 8,000 meters; at 8,126 meters (26,660 feet), it is the ninth highest in the world. Following numerous unsuccessful, sometimes fatal, expeditions, it was first summited in 1953, by the great Austrian climber Hermann Buhl. "In my time, the most technically demanding climb was not any one peak," Reinhold said. "It was surely, at least in the German-speaking world, the south face of Nanga Parbat, the Rupal Face." Even the victorious Buhl, who had climbed by way of the north side, had been intimidated by this massive wall, which he described with palpable amazement as "the highest mountain wall in the world, plunging 17,000 feet in one sheer sweep from the summit into the unplumbed depths."

The leader of the expedition, Karl Maria Herrligkoffer, was not himself a climber, but his half brother, Willie Merkl, had died on Nanga Parbat (his name is commemorated in several of the mountain's landmarks), and Herrligkoffer had come to cultivate the same attitude toward the mountain, vengeful and obsessive, as had Ahab to his whale. By June 26, 1970, the expedition's higher camps and ropes had been laboriously fixed, in very heavy weather, up to 7,350 meters, or as far as the Merkl Couloir, a long vertical gully that was to be the pathway to the summit. One summit attempt had been aborted, and the expedition was weeks behind schedule. Now, Reinhold, his brother Günther, and Gerhard Baur were huddled in the single three-man tent that constituted Camp Five, at the foot of the couloir, poised for a final attempt. At Reinhold's suggestion an elaborate plan of assault had been laid. On receiving the next day's weather report, Base Camp was to signal Camp Five, firing a red rocket for bad weather, a blue for good. If the rocket was red, Reinhold would

REINHOLD MESSNER ARCHIVES, PHOTO BY MARIO CURNIS

make a solo strike for the summit, racing the weather. If the outlook was good, there would be a team ascent. At eight o'clock that night, a red rocket flared.

Reinhold set out in the darkness of the early morning with no equipment save crampons and an ice ax, while Günther and Baur began to prepare ropes in the first 200 meters of the couloir, to aid in the difficult descent. Until this moment, Günther had been with Reinhold every step of the way; now his elder brother—always the leader, always used to getting his way—was en route to the summit and glory, while he was left to handle a tangled mess of frozen rope. Something inside him snapped, and, dropping the ropes, he sprinted after his brother. In four hours, Günther covered the 600 vertical meters of the Merkl Icefield. "Surely," as Reinhold said, "he went at the limit of his possibilities to catch me."

The effects of Günther's extraordinary effort were soon apparent. It was five p.m., late in the day, when the brothers shook hands on the summit. An hour later—a long time—they began the descent. Sluggish and weakening, Günther balked at the difficult route they had ascended. Alarmed, Reinhold sought a quicker route to lower ground, leading them west of the summit ridge where, when darkness caught them, they huddled down for what would be the worst night of their lives. Under the hard, bright stars, the night temperature plunged to 40 degrees below zero. Without a tent, their only protection was a single space blanket. They had no food or water and had been many hours in the "death zone." Günther began to hallucinate, pawing at an imaginary blanket on the ground.

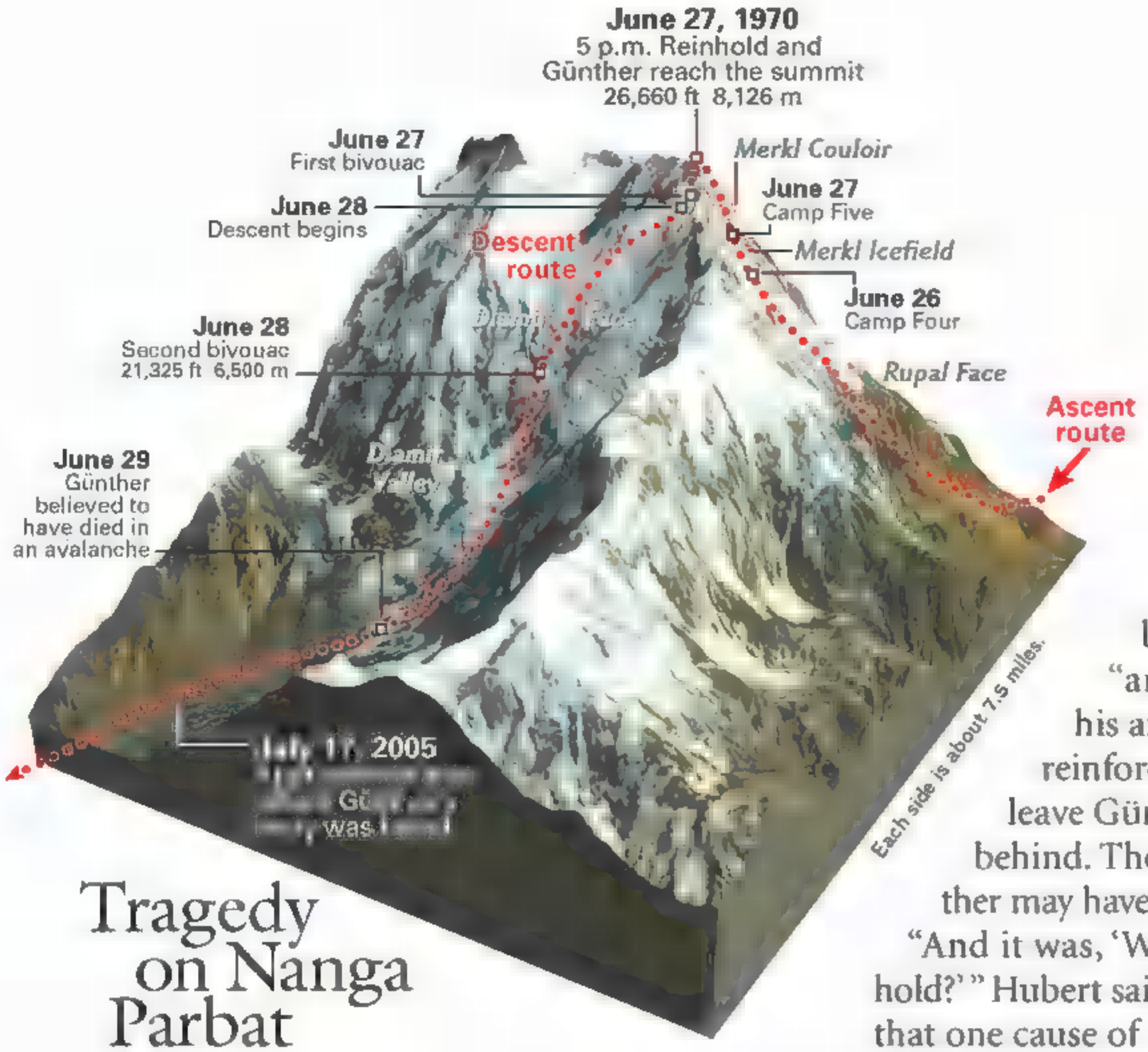
"This is very hard," Reinhold said. "In high altitude, there's no oxygen going to the blood, so you cannot burn, you are not heated. Instinctively, you stay awake as long as possible. You force yourself that the blood is circulating, by thinking. We told also each other, 'Move the toes, don't sleep.' . . . If somebody would sleep, really sleep, it could easily be that he's passing by."

By daylight, Günther's condition was critical. Then suddenly, it seemed help was on the way. Below their bivouac site, the figures of Peter Scholtz and Felix Kuen appeared coming from Camp Four, laboring up the ascent route on the trail the brothers had broken. The ensuing miscommunication between the two parties, shouting back and forth across a divide roughly the length of a football field, remains one of the most unsatisfactorily explained incidents of the Nanga Parbat saga. Scholtz and Kuen are now dead, so their accounts cannot be subjected to inquiry. Somehow, the ascending climbers failed to comprehend the crisis. For their part, the Messners could not know that the red rocket for bad weather had been fired in error. The weather was in fact flawless, and Scholtz and Kuen had come for the summit, not for rescue.

Bypassed by his companions, Reinhold made a bold decision: He and Günther would descend by way of the Diamir Face, on the opposite side of the mountain. "When you are standing there up high, close to the summit, if you look to the Diamir side, it's a very gentle snow slope," said Steve House, an American who climbed the Rupal Face, alpine-style, with his partner, Vince Anderson, in 2005. "It's almost flat; it's easy walking," he said of the initial descent. "The Rupal Face is huge, dangerous, scary. It makes perfect sense to me why he followed that decision."

The Diamir Face had been climbed only twice before, and Reinhold was navigating by instinct. In the night, he and Günther made a second, brief bivouac at 6,500 meters. The next day, under a punishing sun, they continued downward. By 6,000 meters, Günther had partly recovered, and it seemed they were on the homestretch. "From the second bivouac, we could see more or less that there is a way down," Reinhold said. "You can overview a mountain from down, from a certain distance, but never from upwards, and this is very important to understand. . . . Coming from up, you see only abyss; you cannot know, 'I go right, or left'—and this was also the reason why I was forced on the way down to go ahead."

By his own assessment, Reinhold was at times over an hour ahead, out of sight and hearing. Although speed has always been his trademark, he may not yet have understood that his



Tragedy on Nanga Parbat

speed was preternatural. Stumbling down Nanga Parbat, moving with his instincts, he left Günther behind. Seeing a stream, he drank for the first time in four days. Relieved, he waited for Günther to catch up. But Günther was never to appear.

Hansjörg, using the clinical language of his profession, refers to Reinhold suffering a "breakdown" when he realized his brother had disappeared. Reinhold's own account is that he went insane. For a day and a night, he searched the place where Günther should have been, scrabbling with his hands in the debris of a recent avalanche. "I had always a strange feeling that he's around," Reinhold said. "I heard these steps behind me. When I looked back, he was not there. I heard sometimes his voice . . . and I went there, but he was not there. So my intelligence, my clear thinking, told me, 'Your brother's dead.' But my feelings told me, 'Your brother's here.'" At length, his most primitive survival instincts kicked in, and he staggered onward into the Diamir Valley, hallucinating. Two days later, villagers carried him out of the valley. Passed along into the hands of the police, he was on his way to the hospital when the police jeep caught up with the departing expedition, who had given the brothers up for dead. According to one member, Reinhold's first words were to sob: "Where is Günther?"

"I think Reinhold was terribly burdened by not being able to bring his brother home," Hansjörg said, "and I think my father out of his anxiety and a lack of reflection reinforced this guilt: 'Where did you leave Günther?'" He'd left his brother behind. The family's view was that Günther may have been stronger than Reinhold. "And it was, 'Why him, and why not Reinhold?'" Hubert said. Family members speculate that one cause of Günther's desperate summit run had been his unhappiness with his conventional job: "Günther wasn't able to break the rules," as Hubert said. "That was his dilemma. All these questions arise . . . and Reinhold—after this event, Reinhold closed himself up in the family."

For Reinhold, the Nanga Parbat expedition was life-changing. He had lost his brother and closest friend. He had seven frostbitten toes and three fingertips amputated. And he was yet more famous, for when the dust settled, it was Reinhold Messner who had successfully conquered the most challenging wall in the world and traversed an 8,000-meter mountain. The traversing of Everest by a large American expedition in 1963 was then the only comparable feat.

To complicate matters, Reinhold had fallen in love with Ursula Demeter, the wife of Max von Kienlin, who had accompanied the expedition as a paying guest. Shortly after the expedition's return, she left her husband and moved in with Reinhold. "I was a very simple mountain valley man, a young man," Reinhold said. "She knew the big world. And we built up very quickly a successful team. She was doing the correction of my books; she did the handling with my editors." In this era before corporate sponsorship,

MAP SOURCES: REINHOLD MESSNER, USGS, AND NASA. NGM MAPS

to earn a living by climbing required ingenuity and aggressiveness. Without her, he said, "my career, if I can call it a career, would be a different one."

In the fall of 1971, Reinhold took Uschi with him back to Nanga Parbat. "I was hoping that maybe after a dry summer, hopefully a dry summer, the body could come out of an avalanche," Reinhold said. After trekking into the Diamir Valley, they set up a tent, and Reinhold left early the following morning. "The sound of avalanches was thundering around us, night and day," Uschi recalled. Reinhold left the camp at dawn. When darkness descended, she built a bonfire from old lumber, made dinner, and waited. It was long after dark when Reinhold returned. "He was crying and shaking," Uschi said. "He wouldn't eat. He went inside and cried in the night; he cried in his sleep." This was repeated the next day. At week's end, having found no trace of Günther's body, they left.

"After Nanga Parbat the innocent enthusiasm for climbing was gone," Hansjörg said. "Reinhold became"—he paused a long time, searching for the right word—"he became more professional."

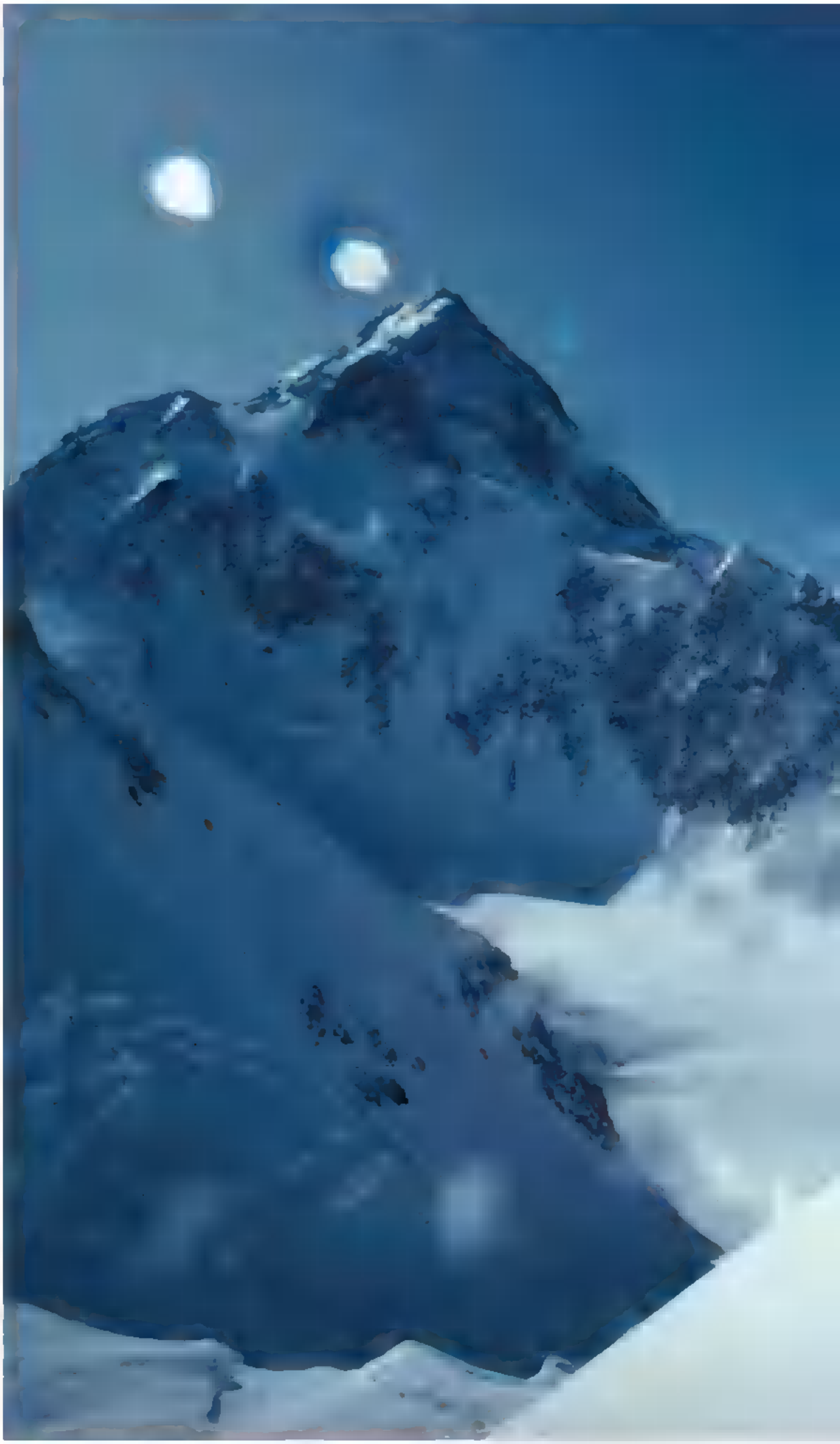
"I am sure that the real key for understanding climbing is the coming back," Reinhold told me. "It means if you are really in difficult places, in dangerous places, if you are in . . . thin air, and you come back, you feel that you got again a chance for life. You are reborn. And only in this moment, you understand deeply that life is the biggest gift we have." Reinhold was speaking from the perspective of a sage veteran of thirty-one 8,000-meter expeditions. There are few such veterans around. "In my generation, half of the leading climbers died in the mountains," he told me. For the 25-year-old survivor of Nanga Parbat, however, there was no question he had returned to climb again.

"During the period when I was in the clinic," Reinhold told me, "I was still thinking, I will probably, after that time of recovery . . . be able to be self-sufficient—I can go to climb anything.

Stumbling down Nanga Parbat, moving with his instincts, he left Günther behind. Seeing a stream, he drank for the first time in four days. Relieved, he waited for Günther to catch up. But Günther was never to appear.

1978 ALONE ATOP NANGA PARBAT

REINHOLD MESSNER ARCHIVES



1982 GASHERBRUM II, ALONG THE CHINA-PAKISTAN BORDER

During his team's ascent, Messner found ■ dead Austrian alpinist under ■ rock. Two years later, Messner returned to climb again—and give the man ■ proper burial. "It cost us considerable time and effort but was necessary."

REINHOLD MESSNER ARCHIVES

"I blinked, and he was gone. He slipped almost the last 400 feet, but he self-arrested with his ice ax." Meeting her, he cried on her shoulder. "When I got him back to the tent, he said, 'Well, I'll never do that again; I'll never solo another mountain like that—I was at my limit.'"

1980 EVEREST, AFTER SOLO SUMMIT

And only during the year '71, I understood this ability will never be like before . . . More than my feet, I lost a little bit of my finger, too, and they cut a little bit of bone, low down, and this bone is pressing on this point"—he held up the ring finger of his left hand. "So with this finger, I could not really work. If you have a little bit of pain on the fingertip, or somewhere, you're not anymore a good climber, because you're always out of concentration. I understood immediately I would never anymore be able to rock climb like in '69, my best year. And so I became a high-altitude climber." This had never been in the original plan: "High altitude was not interesting to me; it was not steep enough—it was hiking, and I would never want to hike a mountain."

Reinhold's own assessment of his most outstanding accomplishments in the high-altitude mountaineering that would define him include the double traverse with Hans Kammerlander of two 8,000-meter peaks, Gasherbrum II and Gasherbrum I, back to back, in 1984, and the solo climb of that mountain of his life, Nanga Parbat, in 1978. But the climb that captured popular imagination was the first ascent of Everest without oxygen, in the spring of 1978.

The very idea was revolutionary. In the 1970s, expeditions typically carried 50 kilos of oxygen per person, for use above 7,200 meters. According to physiologists, to attempt the biggest 8,000-meter peaks, such as Everest and K2, without oxygen was to risk permanent brain damage.

"It was based on nothing," Reinhold said of this view. He had his own experience to draw on. In 1977, while still acclimatized from an unsuccessful attempt on the formidable south face of Dhaulagiri, in Nepal, he had taken a flight over Everest in a small unpressurized plane. "I tried it, and I had a crisis at 7,800 meters," Reinhold said in his most matter-of-fact voice. The crisis was his feeling "a little bit insecure" and an inability to load new film in his Rolleiflex. "Afterwards, I felt quite well, and I was able to

NENA HOLGUIN

do photographs above the summit without a problem, without a blackout." The plane had eventually climbed to 9,000 meters.

The Austrian Alpine Club agreed to allow Reinhold and his partner, Peter Habeler, to accompany their 1978 Everest expedition as an independent two-man team. Habeler was from the North Tirol, the Austrian side of the Dolomites, and had known Reinhold for 15 years and been his partner on hundreds of expeditions in Europe as well as several in the Himalaya. Along with Günther and Friedl Mutschlechner, Habeler was one of the few partners who could keep Reinhold's pace. In 1975, they had made history by climbing Gasherbrum I, the smallest team ever to summit an 8,000-meter peak. According to Habeler, the two had toasted each other at the end of the expedition with the words, "to Everest."

The expedition to Everest without oxygen electrified the public. Reinhold summed up: "It was like going to the moon without oxygen—how is it possible? . . . And in Germany, at least five doctors on television appeared before, going and telling everyone they can prove it is not possible." He smiled his crocodile smile. "And so they prepared the field for a great success."

Physiological tests on Reinhold have revealed a strikingly efficient metabolism—possibly a result of having trained himself to go without food—but nothing unusual regarding lung or cardio capacity. On the other hand, as Reinhold noted with satisfaction, DNA markers from both the maternal and paternal line were rare. ("Yes, the Messners are special," he said.) In his prime, Reinhold trained by running hills—"a thousand meters uphill in 30 minutes," as he told me—but no longer runs much now. Apparently he does not need to. "He's experienced, his body's experienced," Hubert said. Six years ago, they made an 8,000-meter expedition together, and after ten days in the mountains, according to Hubert, Reinhold was "completely fit—but he's only good in the mountains."

Climbing Everest without oxygen confirmed Reinhold's extraordinary adaptation to high-altitude mountains. For his part, he was, as he said, "very, very happy. I was thinking—after Everest, I was feeling I could do anything."

One of the first things he did do was publicly alienate his entire community. At a local festival held to honor the success of the Everest expedition, Reinhold was asked why he had not carried his country's flag. "In my answer, I said I didn't go up for Italy, not for the South Tirol, not for Austria, not for Germany," Reinhold said, laughing hard enough to sputter. "I went up for myself. I took out my handkerchief: 'This is my flag.' Nobody's going up for somebody on Everest. You go by yourself, and you handle it yourself." His tone darkened. "All this nationalistic chanting makes me angry. I cannot stand it." The necessity of opposing "fascists" and "Nazis" is one of Reinhold's favorite themes; he is fond of pointing out that the German Alpine Club banned Jews from membership in 1921 and posted signs on remote mountain huts to this effect, and he credits acceptance of such actions to what he calls the German "sheeplike" reverence for authority. "My *übermensch* is a self-determined person who would never accept something, some rules from up high up," Reinhold said, paraphrasing Nietzsche. "He would say, This is my way, and I go this way. And this would be the great enemy of the fascist."

Extreme self-determinism, however, has drawbacks. Shortly after he and Peter Habeler made history, they fell out. They later reconciled, but the long estrangement was part of a professional pattern. "The expedition is one thing, but after the expedition is something else," Arved Fuchs said. In 1990, he and Reinhold had made the first crossing of the Antarctic continent on foot; Reinhold had moved on from mountaineering to Stage Three of his life, exploring the horizontal world. "This is something I just don't understand," Fuchs continued. "This man is known all over the world, he sets up new standards as far as mountaineering goes, he is very successful, probably very wealthy, but he has never made his peace with his success and with himself; and this I think is the tragedy of his life."

"When I finished the 8,000-meter peaks, I understood, now I could only repeat myself. What I did is boring now. But I like to go somewhere where everything is new, and to begin again an activity."

1992 IN CHINA, CROSSING A DESERT ON CAMEL

"Reinhold as an alpinist is the best, the finest in the world," Hans Kammerlander said. "But he has some weaknesses. I speak as a friend," he said in a tone of great gentleness. "He cannot take criticism, and he is quick to attack if he is criticized."

"I expose myself, I accept the natural powers as the rulers of my world," Reinhold said of being on the mountains. "There's no more human rulers if I'm out there. There's no religion which is controlling me and telling me how I have to behave. There's just pure nature, which I have to respect. The nature in myself, and the nature outside." The freedom of the mountains evidently means freedom from other people.

In 2003, Reinhold returned to Everest's Base Camp to celebrate the 50th anniversary of its conquest. "I needed more than two hours to go from one end of the base camp to the next," he said, his incredulity mixed with unconcealed contempt for what he calls the "city culture" that has infiltrated the mountains, destroying their solitude with its ubiquitous Internet connection to the world below.

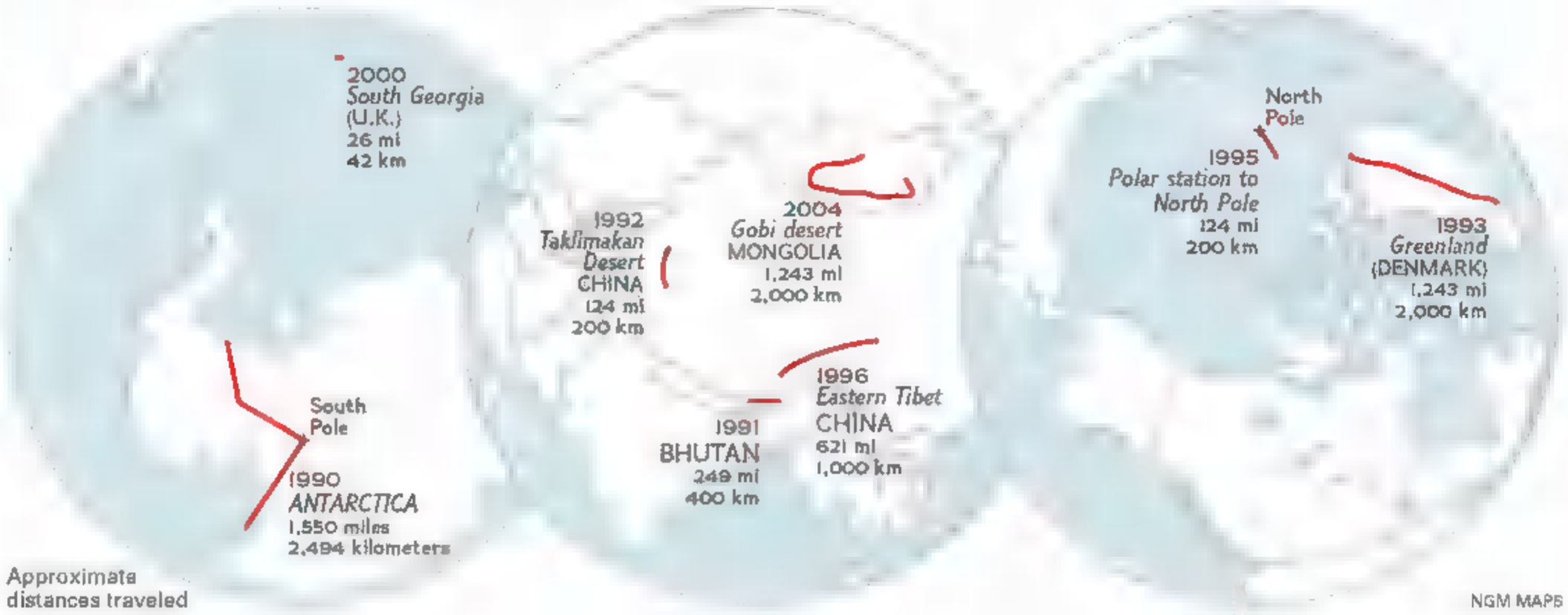
For him, climbing Everest without oxygen opened the way for the ultimate feat of lonely self-determination: Climbing Everest solo, a dream inspired by heartfelt, lofty ideals—and also some down-to-earth competitiveness. What specifically galvanized Reinhold into action was an announcement by Japanese climber Naomi Uemura that he had obtained a permit for a solo attempt in 1980. In his book, Reinhold candidly records his own reaction: "How can it be true? It is my idea!"

The permit Reinhold obtained for a solo climb in 1980, by way of Everest's North Face, was one of the very first issued by the Chinese since their occupation of Tibet in 1950. He and his small party—a mandatory Chinese liaison officer, an interpreter, and one companion who also acted as a medical attendant—would be the only people on the north side of the mountain.

Reinhold's choice of companion was unconventional: Nena Holguín was a 30-year-old American who had hiked across parts of South America and islands in the Pacific before working in the Himalaya, building schools for the Sir Edmund

REINHOLD MESSNER ARCHIVES

Messner's horizontal feats



Hillary Foundation. Today the owner of a hiking tour company in the Canadian Rockies, she and Reinhold had met in 1979, following his expedition to Ama Dablam. On Everest, their single-tent advanced base camp was set up at 6,500 meters; the two Chinese escorts remained at a lower camp. "It was only Reinhold and I and a wolf, who came to the camp when I was alone and was chewing on the bones outside of my tent," Holguín said. She had the full-time duties of expedition cook and all-purpose helper. They remained between the two camps for a month before Reinhold set out on the morning of August 18.

"Reinhold had already soloed about 2,000 mountains at that point," Holguín said. This included his remarkable solo ascent of Nanga Parbat. "People don't think of it as easier, but it's easier sometimes to do things alone because there is nobody you have to cooperate with, as long as you can get past the aloneness. He likes to do things exactly at his own pace and his own style. It's easy to do things alone if you already know you can do them. He trusted himself."

The historic climb got off to an almost fatally bad start when only 500 meters from camp, in the darkness, Reinhold slipped into a crevasse. Higher up, soft snow made the climbing arduous; being alone, there was no one to share the task of breaking trail. He would spend three nights on the mountain.

"In the Alps, it was easy," Reinhold said. "I started in the morning, and in the evening I was back. Being alone is becoming difficult in the nights. Climbing, there's no problem—you are climbing. Staying alone in dangerous places, icy, cold places for nights and nights and nights is much more difficult." Reaching the summit, Reinhold registered only dull emotions. Mist came in, and light snow blurred his footprints. He turned mechanically for the descent, conscious of deteriorating mental keenness, a dangerous indifference to his condition.

"I finally spotted him on the third day coming down," Holguín said. "I was watching him, and I was watching him, and I was watching him—and I blinked, and he was gone. And he had actually fallen down—he slipped almost the last 400 feet, but he self-arrested with his ice ax." Meeting her, he cried on her shoulder. "When I got him back to the tent, he said, 'Well, I'll never do that again; I'll never solo another mountain like that—I was at my limit.'"

In 1986, Reinhold climbed Lhotse, and in doing so became the first man to attain all 14 of the 8,000-meter mountains. "When I finished the 8,000-meter peaks, I understood, now I could only repeat myself. What I did is boring now," Reinhold said. "But I like to go somewhere where everything is new, and to begin again an activity."

Reinhold's silver Mercedes SLK sped out of Bolzano, toward the mountains and Schloss Juval, his castle home. A striking key chain dangled from the car's ignition: an animal's talon attached to a lump of sand-colored fur. "It is a yeti claw," said Reinhold, and laughed. Stage Four of the Messner itinerary through life was devoted to holy mountains and myths, and included stalking the legendary yeti, the Himalayan equivalent of Bigfoot. This pursuit of what he eventually identified as the Himalayan brown bear earned Reinhold great ill will in German climbing circles. "The yeti story undermined him in elite alpine culture," Hans Kammerlander said. It seems that German climbers, stumbling back from their own mountain epics, had been greeted not with the acclaim, respect, and book offers of which they had dreamed but—thanks to Reinhold Messner—with the facetious question, "So, did you see a yeti?"

Like a brigand's retreat, Juval stands sternly on a 3,000-foot-high cliff, guarded by soaring, snow-streaked mountains and commanding a view over lesser mortals in the Senales Valley. Reinhold's acquisition of the 13th-century schloss in 1983 fulfilled several dreams. Here, with his impeccably managed organic fields, animals, and vineyards, he could be a farmer, something he claims he has always wanted to be: Mountain farming is Stage Five. More important, Juval offers "self-sufficiency," one of Reinhold's favorite terms, a place where he could, if necessary, hunker down and live well, keeping the rest of the world at bay.

Juval was also the site, in 1998, of a climbing tragedy. Locked out of his castle one rainy night, the world's greatest mountaineer scaled its walls and, dropping 20 feet into the darkness, landed badly and fractured his heel. The injury was severe enough to curtail him and still gives pain. The realization that he would not be in top form for many years partly prompted his decision to become a member of the European Parliament. The ability—as after Nanga Parbat—not merely to regroup but to turn his back on something he had long loved, seems the secret of his constant reinventions. Asked the issues on which he had made the most difference during this five-year tenure, Reinhold looked amused. "Nobody made any difference," he said. The political career, from 1999 to 2004, did not even warrant a life stage designation. In celebration of its conclusion he fulfilled an old dream, at the age of 60, of crossing the Gobi desert.

Most of the year, Reinhold and his family live not in the mountains at Juval but in the attractive nearby town of Merano. On returning to his apartment there, Reinhold opened the door to a low, rumbling sound coming from the kitchen. "I don't know what is that noise," he said, perplexed. A baby dragon? Tibetan prayer flags whispering over a chorten? "I think it's a vacuum cleaner," I offered cautiously, and was reminded of an earlier statement he had made regarding his domesticity. "I would not know even where to go if the light is off or the heating does not function," he had said. "I'm really living like in my mother's house. That's very nice." The Messner household seemed well-run and happy. "Our system is much stronger than a marriage," Reinhold said of his 19-year relationship with Sabine Stehle, describing it as a partnership in which specific spheres of authority are clearly defined. (In the interest of her family's privacy, Stehle preferred not to participate in this story.) "We live in a matriarchy here, so we will see what happens," he remarked on another occasion, concerning some issue with his teenage daughter.

Later, Reinhold's younger brother Hubert dropped by. Hubert had accompanied his famous brother on a number of the horizontal ventures, including the crossing of the Greenland ice cap, and in the summer of 2000, he had joined Reinhold and two friends on an expedition to Nanga Parbat; it was the 30th anniversary of Günther's death.

"We decided to climb Nanga Parbat on a completely new route, a very beautiful route," Hubert said. "I didn't go to the summit. I stopped on 7,300 meters. I stopped there because I felt not mentally strong." They ascended by way of the Diamir Face, and Reinhold pointed out the place

where he thought Günther had died. "We had perhaps all these strong feelings, and it's difficult," Hubert lowered his voice, his words suddenly stumbling. "In the tent, he was calling me every time Günther."

The 2000 expedition to Nanga Parbat may have been the catalyst for Reinhold's decision, in October 2001, to reopen old wounds from the 1970 expedition. The public occasion he chose was a press conference hosted by the German Alpine Club to celebrate the publication of a biography of Karl Maria Herrligkoffer. Instead of making expected words of polite praise, Reinhold lashed out at the expedition members: "Some of them, older than me, wouldn't have minded if the two Messners hadn't returned."

The backlash against Reinhold was extreme. Two expedition members, Hans Saler and Max von Kienlin, the paying guest, published books making serious claims: Not only had the young Reinhold Messner always intended to make the historic traverse of Nanga Parbat, but he had also left Günther to die on the Rupal Face, while he crossed over and descended the Diamir Face. Several team members reported memories of Reinhold studying maps of both sides of the mountain: "He told me about the traverse in the evening by the fire in base camp," Jürgen Winkler recalled. A distinguished alpine photographer, he was one of the two 1970 expedition members present at the press conference when Reinhold shocked his audience. But would the young Reinhold Messner, ambitious as he was, really have been so reckless as to set out, on his first Himalayan expedition, to traverse an 8,000-meter mountain without a rope or bivvy bag and supplied with only a handful of nuts and raisins and a bottle of water?

"Reinhold Messner is *un homme extraordinaire*," Winkler said, by way of answer. "There is no second person in the world like Reinhold Messner."

Of his search for Günther's body, Reinhold told me, "I was hoping like a dream—maybe late in the year, when the sun has taken away part of

Reinhold's own account is that he went insane. For a day and a night, he searched the place where Günther should have been, scrabbling with his hands in the debris of a recent avalanche. "I heard sometimes his voice, but he was not there."

2005 [redacted] PARBAT, GÜNTHER'S CREMATION

STEFAN NIMMESGERN/STARSHOT FOTOFACTORY

the avalanche cone . . . maybe he would appear." In the warm summer of 2005, out of the fog of libel suits and acrimony, this dream materialized. As if relenting of all the damage it had wrought, Nanga Parbat gave up its dead. On July 17, at 4,300 meters in the Diamir Valley, three Pakistani climbers came upon the remains of Günther Messner, identified by a detail on his old, pre-1980 leather climbing boot. The identification was later confirmed by elaborate tests of both mitochondrial and Y-chromosome DNA of that rare Messner genome, conducted by the Institute of Legal Medicine, Innsbruck Medical University.

Back on Nanga Parbat, Reinhold, knowing that a member of the 1970 expedition had been on the Diamir Face making a docudrama about the mountain's tragic history, feared that his brother's body could be exploited or even relocated. After consultation with his family, Reinhold cremated Günther's remains on the mountain.

Speaking to Uschi, I asked if the discovery of Günther's body on the Diamir Face had at last lifted a burden from Reinhold. She stared at me: "No. He always knew Günther was there."

"I give all of myself, all of my energy, my time, my money, my enthusiasm," Reinhold said. He was not speaking about 8,000-meter expeditions but about his latest museum. Family and friends had remarked on the pressure he had put himself under, and the new intensity and frequency of his rages. As opening day drew closer, the undertaking seemed to strike him as increasingly epic, and he was reaching for metaphors to compare it to extreme climbing. It involved all the elements he had identified as essential to the "strong experiences" that test one's limits—difficulties, strenuous effort, exposure. But not the risk of death, as I reminded him. "I can do like Hemingway," he replied, glumly.

When complete, the chain of five Messner Mountain Museums will form a neat circuit in the South Tirol; eventually, they will run themselves. "This is a dream of mine, that they should go without me—like how it is in the family," he mused. When total self-sufficiency in all aspects of his life has been attained, he will be free to follow another long-discussed, never actualized dream, and retreat to a cave. "I would prefer somewhere in the Dolomites," he said. "There are so many good places . . . I would stay maybe a month there and write, or think, or enjoy the morning light, climb a mountain. That is a very strong daydream, that I am a free person."

Photo Gallery Find more images of Reinhold Messner and browse a listing of related links and resources at **ngm.com/0611.**

He paused. "I am not a free person anymore."

Why not just retire? "Reinhold doesn't really relax," Hansjörg said. "Do you know this saying he has on his website? 'I am what I do.' But I think he may also believe the opposite: 'If I cease to do, I will not be.'"

How far Reinhold has traveled, from Stage One to Stage Six, is demonstrated in a film taken when he was in his late 20s, showing him climbing a sheer rock face in the Geislerspitzen. Like water flowing upward, he ascends the tower; his fingertips scarcely press the surface.

His new challenge: a network of Messner Mountain Museums like this one in Bolzano, Italy. "I was very lucky that I found something new, where I could put all my enthusiasm."

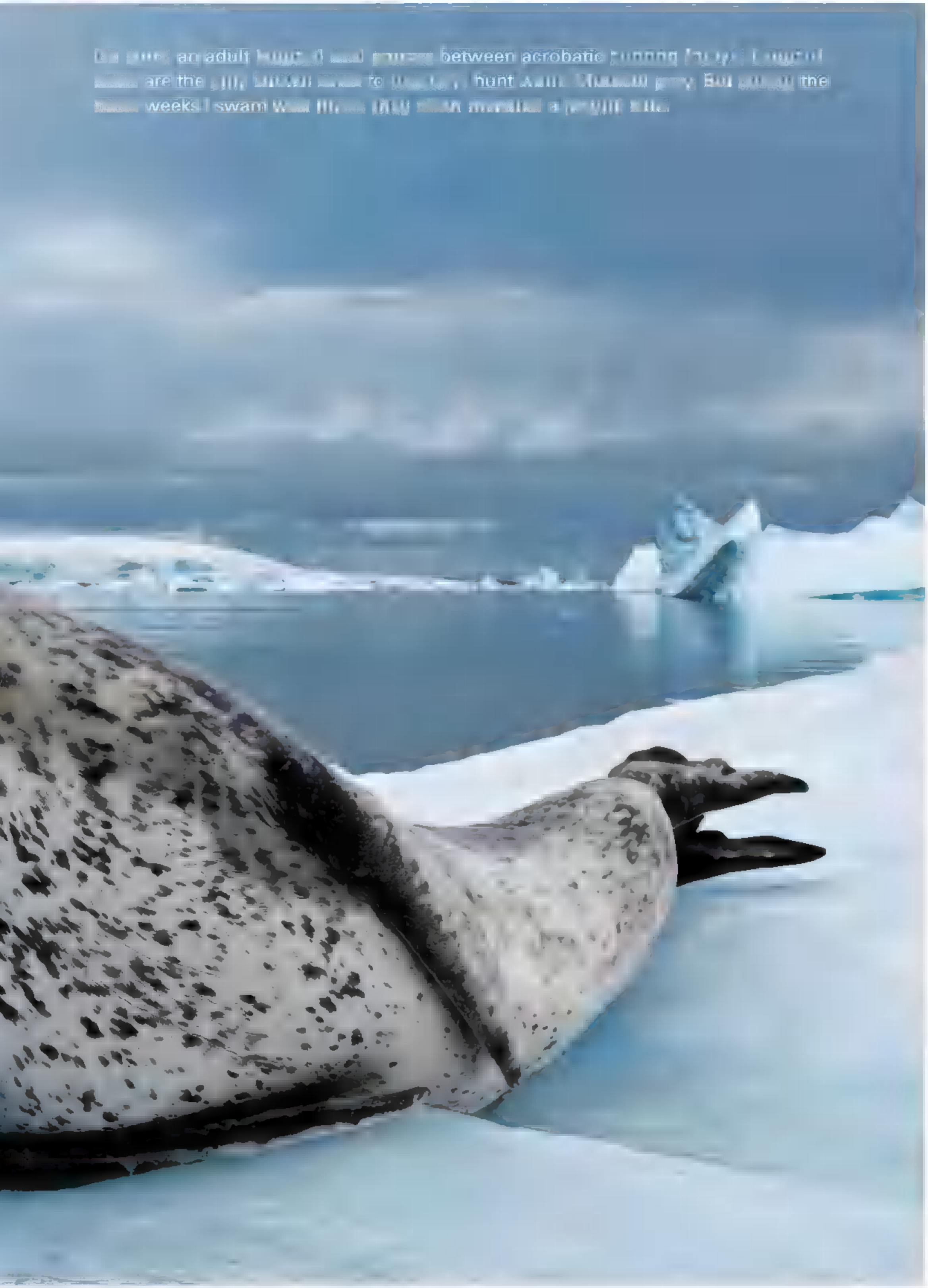
His expression is of otherworldly reverence. "There are moments in difficult situations, far away, that there is no more doubt," he told me. "There, the questions are gone. And I think these are the important moments. If the question is gone, I have not to answer. Myself living —I am the answer." □

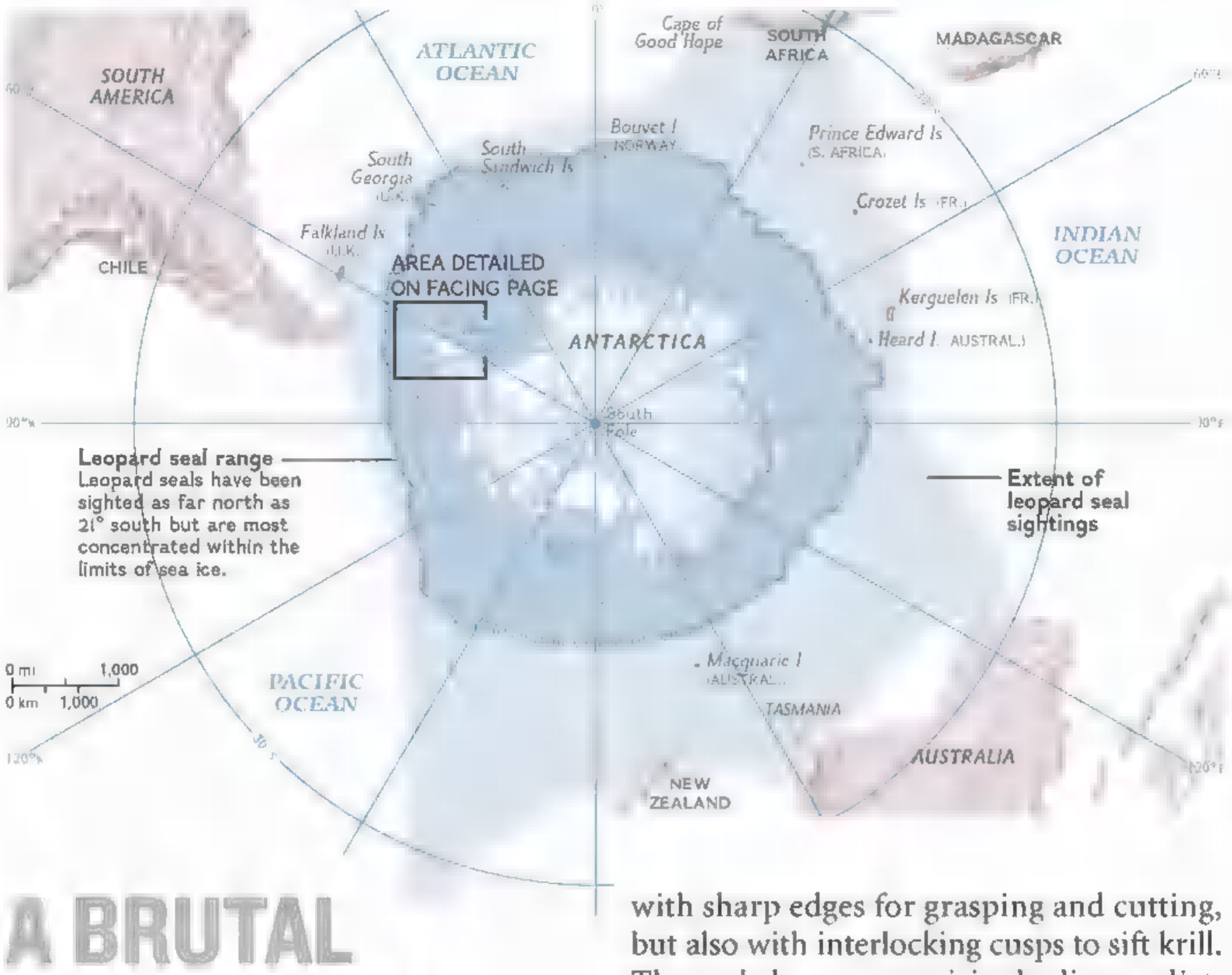
DEADLY BEAUTY

A PHOTOGRAPHER FALLS UNDER THE SPELL OF ANTARCTICA'S LEOPARD SEALS

PHOTOGRAPHS BY PAUL NICKLEN

I expected this 12-hour-long female to flee with her catch, a live penguin chick, but instead she dropped it on my camera. Then she opened her mouth and engulfed the camera and most of my head. After 45 minutes of noisy throat-pecking, she finally relaxed and ate. The next day, as if wanting an audience, she came looking for me.





A BRUTAL REPUTATION

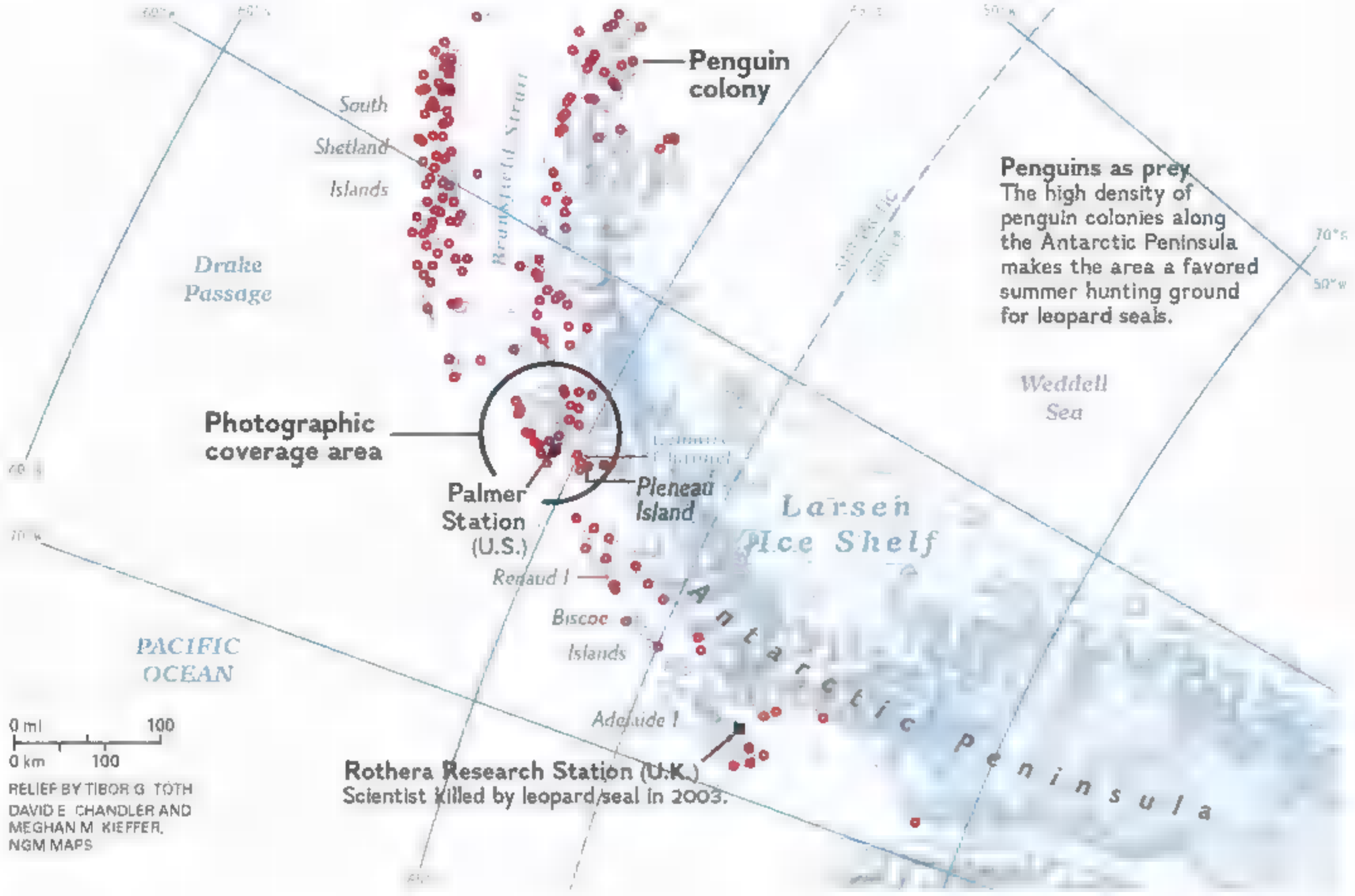
Of all the seals in the world, only one, the leopard seal, has the reputation of a true hunter, a top predator. At up to 12 feet long and more than a thousand pounds, it moves with surprising agility and speed, often along the edges of ice floes, patrolling for penguins and other prey. "Sea-leopards," early explorers called them. A "fierce, handsome brute," wrote Frank Worsley, Sir Ernest Shackleton's skipper on the famous 1914 *Endurance* expedition. The name comes from the seal's patterned skin, which Worsley described as "a fawn coat spotted all over with brown markings."

Every austral summer, leopard seals wait in shallow water off major penguin breeding colonies to capture newly fledged birds going to sea for the first time. The seals' teeth tell the story: front canines and incisors designed to capture and shred their prey; back molars with sharp edges for grasping and cutting, but also with interlocking cusps to sift krill. The seals have a surprisingly diverse diet: krill, penguins, other seals, fish, and squid—anything they can get their canines on. The other seals on the menu are crabeater seal pups, or, off the island of South Georgia, Antarctic fur seal pups.

Leopard seals have been seen as far north as the coasts of Australia, South America, and South Africa. Their true home is circumpolar Antarctica, where they seem to fill more space than their actual size. Think of tigers in India, lions in Africa, grizzly bears in North America.

Göran Ehlmé, a Swedish cinematographer, has spent years in the water with leopard seals: "It's not strange that the seal has the reputation it has. The first time I saw one, I got scared. The big head. The large mouth. The sinister eyes. The icy water added to the fear. I had to rethink things through a bottle of whiskey and a long sleep."

Ehlmé had heard stories. He knew about a leopard seal attack on a member of Shackleton's crew, Thomas Orde-Lees, who was



skiing across sea ice when a leopard seal emerged from between two floes and lunged after him in bold, snakelike movements. Orde-Lees managed to keep ahead, kicking and gliding, until the seal dived into an open lane of water and tracked him from below—following his shadow—to pop up ahead. Orde-Lees turned and yelled for help. The seal pursued until it was shot dead by Frank Wild, Shackleton's second-in-command.

The seal's reputation took another dark turn in July 2003 when Kirsty Brown, a 28-year-old marine biologist snorkeling off the Antarctic Peninsula, was grabbed, pulled down, and drowned. Her colleagues worked for an hour to revive her, but could not.

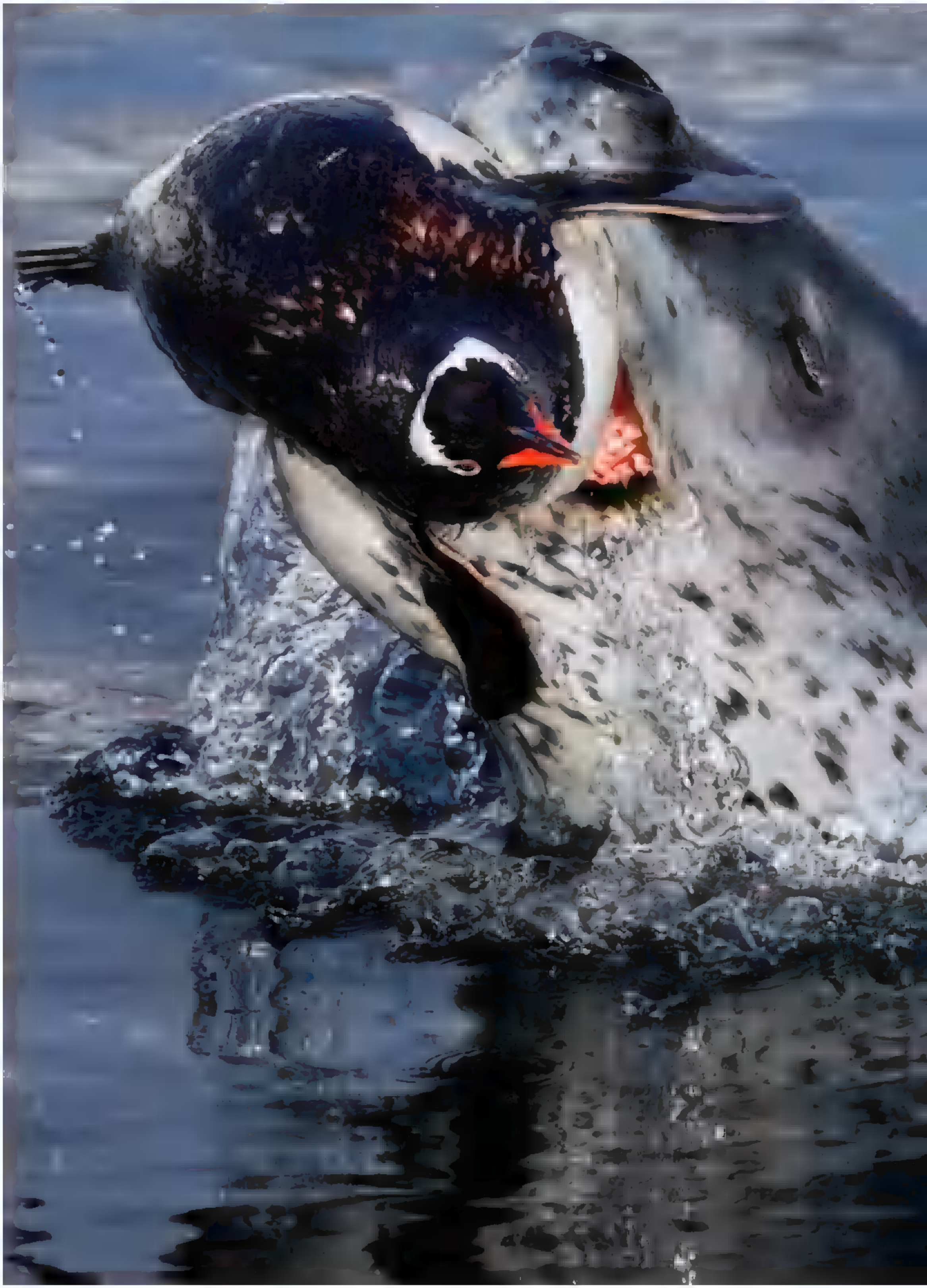
Leopard seals had punctured inflatable boats. They had now and then harassed people. But never before had they caused a documented human fatality.

"It makes a better story to tell about a ferocious animal than it does to tell about a curious one," says Ehlmé. "People tend to judge animals in frightening moments. But these seals, they are mostly curious. I tell other divers, 'If you get scared, just close your eyes. Then open them. The seal won't bite you, but it will be very close.'" (Antarctic research stations now advise anyone not studying leopard seals to postpone a dive, or to get out of the water, when they see one nearby.)

Photographer Paul Nicklen took Ehlmé's advice as he slipped into the cold sea of Antarctica and found an animal capable of ferocious acts and delicate gestures. Before his eyes a leopard seal—sometimes only inches away—would shred a penguin, or offer it to him whole.

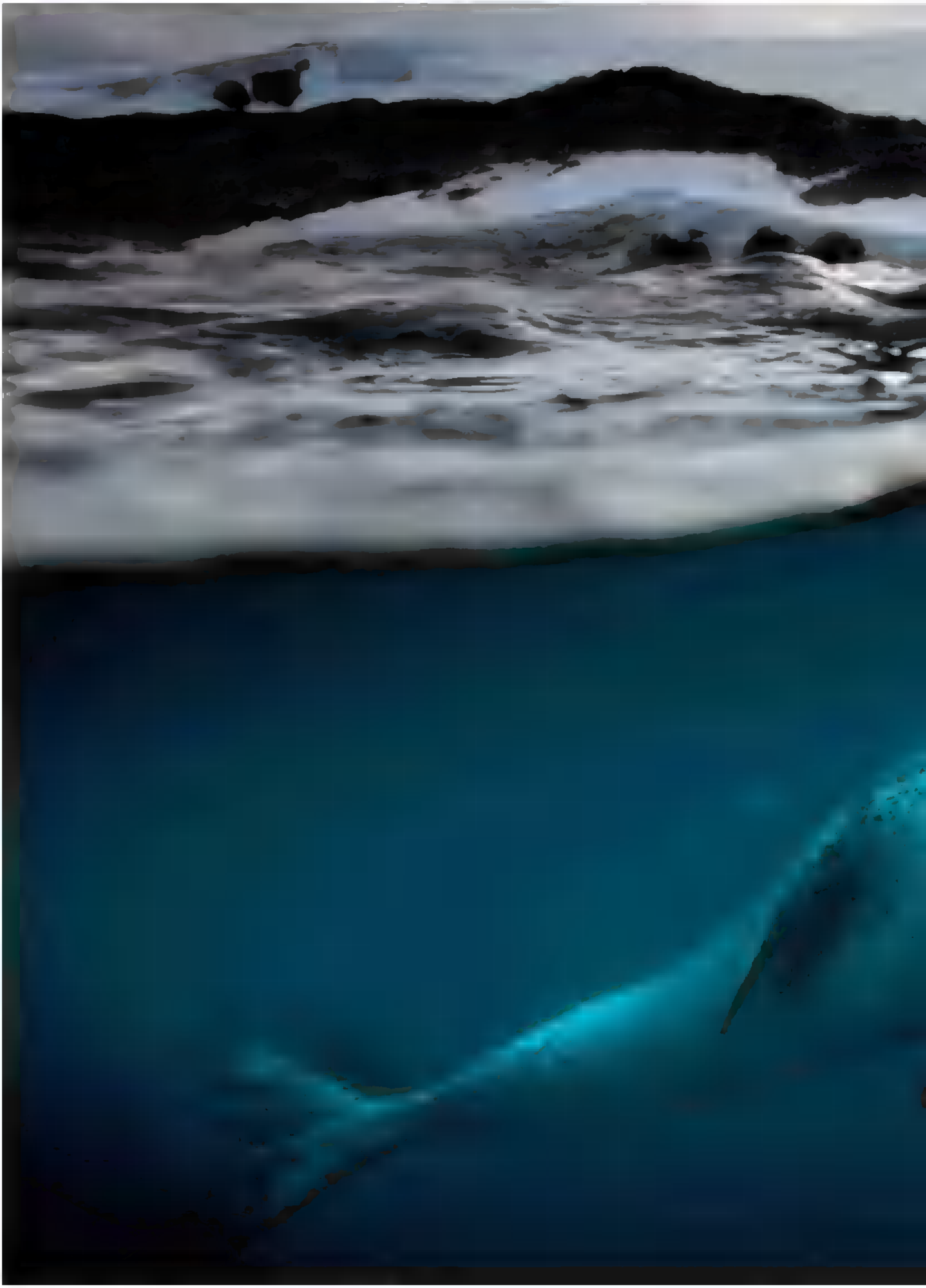
As Shakespeare wrote in *Othello,* a reputation is "oft got without merit and lost without deserving." Perhaps it comes down to this: We cannot know a seal, or any wild animal, until we gently enter its home, where it keeps the truest part of itself. In so doing we learn more about ourselves, another top predator, forever curious. —*Kim Heacox*

Solitary Hunters Experience the Sights & Sounds of leopard seals with photographer Paul Nicklen in a multimedia show at **ngm.com/0611**.

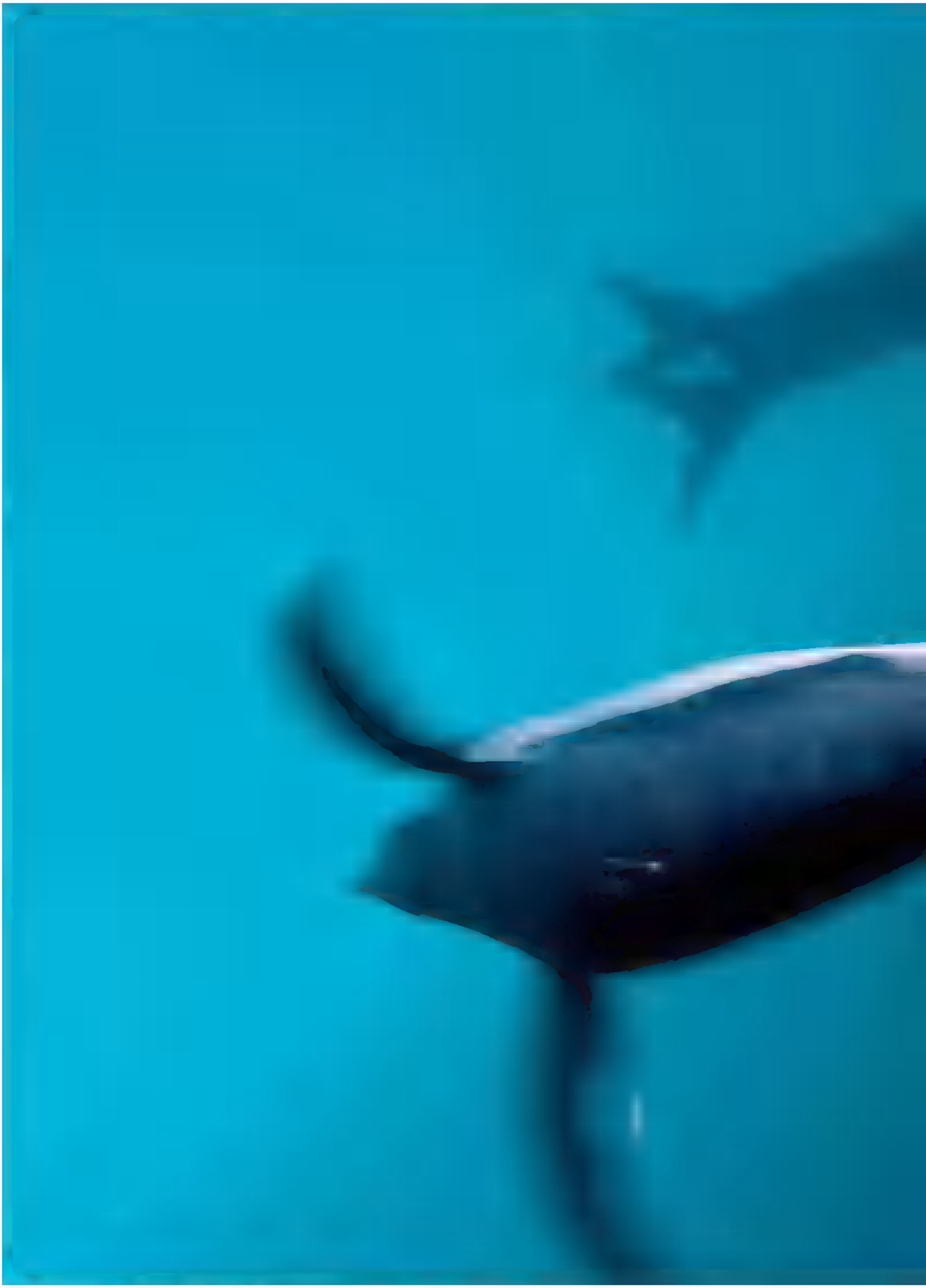


A [illegible] seal [illegible] with a [illegible] [illegible] krill [illegible] seals as [illegible]

Going to sea for the first time, gentoo chicks linger on snowy Pleneau Island as the last of their down is replaced by waterproof feathers (below). With leopard seals patrolling offshore, young penguins circle each other, waiting. They hop into the water, hop out, and peek beneath the surface (left) until one dives in. The rest quickly follow. The race for survival is on.



This seal
their numbers. Estimates range from
to

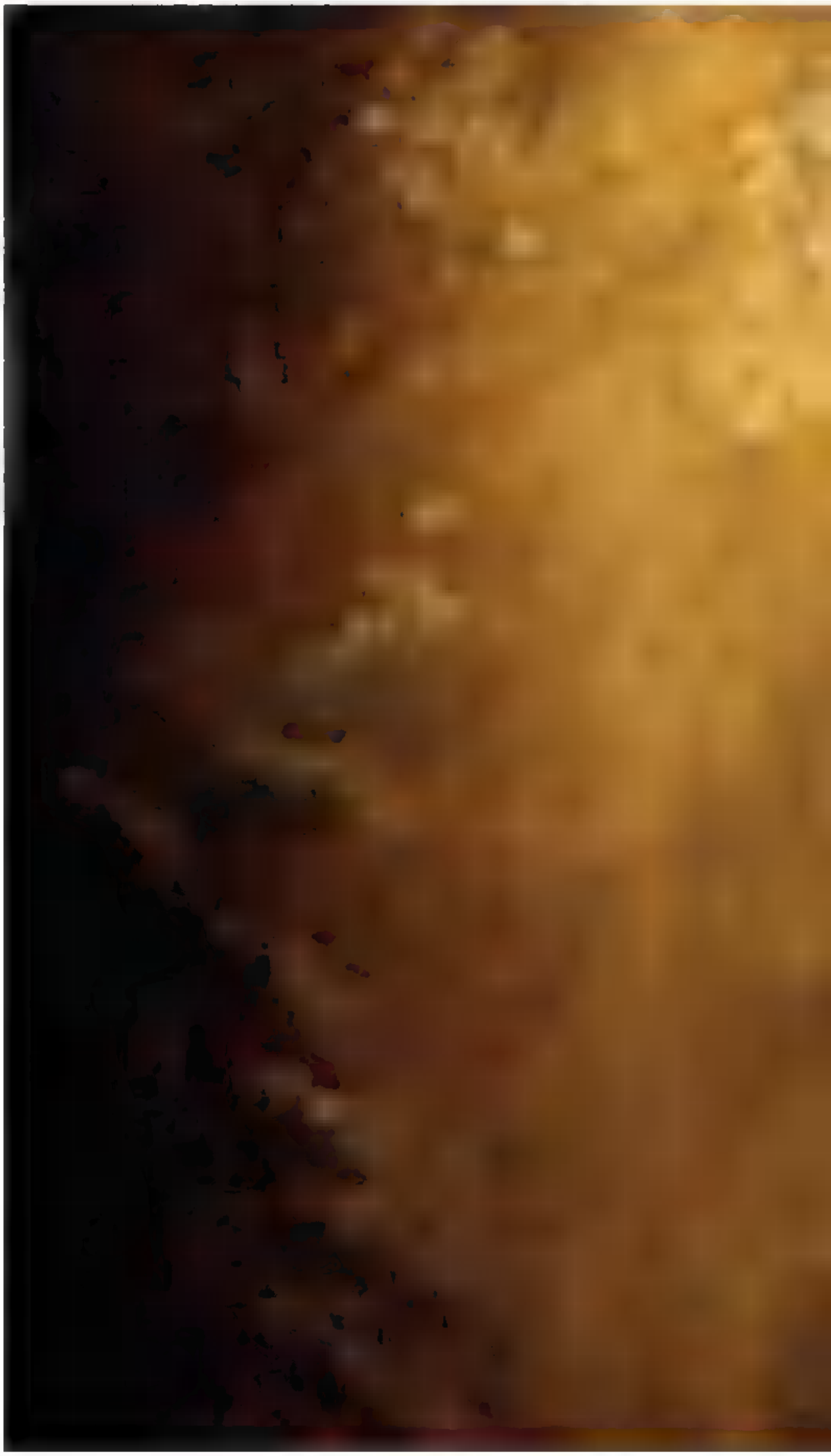



More frightening than the canines of the large female was the deep, throaty sound she let loose that rattled through my chest. She was warning off another leopard seal that had snuck behind me. It worked—the visitor moved on

In a death shake (below), the large female shreds a penguin chick by whipping it from side to side. It took 1/2000 of a second to freeze the action; at the time all I saw was a splash and storm petrels and gulls gathering for scraps. This efficient killing machine prizes above all else penguin stomachs stuffed with krill. The seals have a harder time catching the faster adult penguins. It took one male (left) five minutes to grab an adult gentoo.

The large female dives to eat her prey. Because leopard seals eat whatever is available, scientists track their diets to help gauge changes in the food web caused by global warming. The Antarctic Peninsula is one of the most rapidly warming places on Earth. By chemically analyzing a seal's whiskers, scientists can glean roughly three years of feeding patterns.

Aboard from a morning hike, a leopard seal rests on a piece of freshly calved glacier ice in Lemaire Channel. I had arrived in Antarctica nervous and aware of the animal's fierce reputation. I left humbled, knowing I had experienced a powerful and rare meeting in the sea.



In this South Texas border town, it doesn't matter whether you're Anglo or Mexican. All that counts is old blood, deep roots, and the size of your hoopskirt.

Once upon a time in Laredo

Resplendently retro, debutante Ann Michelle Hinojosa poses for a portrait before her presentation at Laredo's Colonial Ball and Pageant. It's part of an annual celebration of George Washington's birthday, and a snapshot of a community coming of age.

By Mimi Swartz • Photographs by Penny De Los Santos

Matriarchs of one of Laredo's most accomplished families, Teresa Flores and her daughter Barbara Cigarroa, at right, were never pageant debutantes. "It didn't occur to me, or to my girls," says Barbara. But when her granddaughter Alyssa saw the gala, "she was entranced."

The world of the Texas-Mexico border has always been inscrutable to outsiders. Consider the pageant presented by Laredo's Society of Martha Washington—part of a month-long celebration of George Washington's birthday, held since 1898. The notion of honoring our founding father and his kindly wife a stone's throw from Mexico seems almost comical. It's hard to associate that particular George W. with the dry, dusty scrub of South Texas. Laredo's blocky Civic Center, where local debutantes are presented in an annual and very lavish tribute to Mrs. Washington, is a far cry from the serene repose of Mount Vernon. Yet the ability to take a leap of faith into another world is what the border has always been about. Those who make the place their home know how to live in at least two worlds, accepting both and judging neither.

So on a blustery Friday night in February, a stage has been transformed into a replica of the Washingtons' drawing room, right down to the twinkling crystal sconces and the pale green, period-hued walls. Seventeen local belles make their debuts, teetering across the stage in elaborate gowns while a narrator praises Martha Washington's simple virtues with a solemnity that would satisfy the finickiest member of a First Family of Virginia.

But because this is the border, the first First Lady is extolled bilingually: Martha was "*la primera dama de nuestra nación,*" who "put her country and the General above herself." And, also because this is the border, there is something just a bit zany about the celebration. When you combine the psyche of wealthy Mexico with that of wealthy Texas, more is always going to be more. Debs in New York might display their well-practiced curtsies in spare white gowns and gloves, but these girls make their bows in dresses of gleaming satin and thick velvet, so encrusted with ruffles, beads, and lace that they elicit gasps from the audience. Two notable Laredoans have been chosen to portray George and Martha, and on this, supposedly the President's last night in office, the First Couple's life is reenacted, with the debutantes and their escorts all playing roles. As each young woman is introduced, violins or the U.S. Army fife and drum corps playing, it is

noted whether her mother or grandmother or great-aunt made her debut as "a Martha," whether her father or grandfather or great-uncle ever played George Washington, and whether she or her escort—from an equally fine old family—was ever an "*abrazo*" child: Every year a boy and a girl from Laredo embrace their counterparts from across the border in Nuevo Laredo on the International Bridge before a huge, cheering crowd, epitomizing the love that people on both sides have for each other.

And so life has gone for more than a century here, where the cultures have not so much collided as colluded to form one region, separate and apart from both home countries. The two Laredos, it has been said, beat "with one heart." This particular stretch of border is both baroque and byzantine, the most stratified and status-conscious of border towns, part Texan, part Mexican, and somewhat American, with rules, rituals, and folkways that have grown as complex and vibrant as the bougainvillea that blooms along columns and rooftops in so many local yards.

It would be easy to make fun of Laredo and its pageant. In these days of war, famine, global warming, and the ever growing divide between rich and poor, an elaborate tribute to Martha Washington by debs wearing gowns that weigh 85 pounds and cost in the neighborhood of $30,000 is something of an easy target. Recently, however, change has come to the region—in the form of drug violence across the border and, emanating from Washington, battles over immigration—threatening a way of life that has persisted here since the first Spanish settlers arrived in the 1700s. This year, despite the jeweled gowns and effusive abrazos at the celebration, it was natural to wonder whether Laredo's oldest families were honoring the past or clinging to it. And that didn't seem funny at all.

Alyssa Cigarroa had always dreamed of becoming a Martha. At 17, she is a beautiful young woman with shimmery brown hair, dancing eyes, and a wide, dazzling smile. She began reading the annual Sunday supplement featuring the debutantes when she was five. At seven her grandmother, Barbara Flores Cigarroa, took her to her first pageant. But wanting to be a Martha and actually becoming one are two very different things. None of the women on the Cigarroa side of the family had ever participated in the pageant, and in the rules governing this societal ritual, precedent can be a formidable obstacle.

Though the Martha Society's past president, Veronica Castillón, makes joining the organization sound as easy as sending in an application—"It's not complicated," she says blithely—women can spend up to eight years on the society's waiting list so their daughters can be selected as debutantes by longtime members. Some women are never picked at all. The ones who are come mostly from a small, elite group of old families. People like Linda Leyendecker Gutierrez and her sister, Jennie Reed—heirs to an oil-and-gas fortune bounteous even by Texas standards. Their grandfather played George Washington in 1905; both women are married to the men who were their pageant escorts; and their daughters made their debuts a few decades later.

Like many of the close-knit Laredo clans, the two sisters grew up in St. Peter's Plaza, a tree-lined neighborhood of genteel homes—big but not McMansions, 19th, not the 20th century. Greeting me on a generous, sun-dappled porch are two women who could not appear more different. Linda is as dramatic as Jennie is reserved. Linda speaks forcefully, wears her hair loose, favors flashy jewelry and a low cut T-shirt, while Jennie, the elder, waits her turn to speak and wears her hair in a tight bun. Both women have devoted their lives to the Martha Washington Society. Jennie is the organization's publicist and unofficial historian, while Linda, for the past 30 years, has designed the lavish gowns that are the highlight of the celebration. "The girls are born, and the mothers call me from the hospital," Linda says, speaking in speedy, lightly accented English. To a small group of very rich people, she is arguably the most important woman in town.

At her atelier in one of the four homes she owns in St. Peter's, Linda has covered the walls with color photos of girls in their gowns. A dress hangs on a mannequin in a downstairs workroom. It glitters in the sun streaming through the windows, Laredo's version of the crown jewels displayed at the Tower of London. Like wedding dresses that stay in families for generations, some Laredo debs even recycle, or, rather, upgrade,

Despite her family's good standing, Alyssa Cigarroa's participation in the pageant was uncertain. When the call finally came, she was elated—and ready for the ten months of preparation and parties leading to the big night. "I enjoyed every bit of it, especially the dresses," says Alyssa, who helped bead her own gown. For some Mexicans in Nuevo Laredo (below, background), the American dream is just across the bridge, yet a world away.

Getting used to a more formal (and much wider) profile, debutantes try out their hooped petticoats at a practice run. Even with escorts on hand, walking and dancing in gowns that weigh 85 pounds proves no easy feat, and leaves many girls with bruised hips.

gowns that once belonged to their mothers or grandmothers, a cost-cutting measure that is only applauded when it includes the copious application of still more ruffles, beads, sequins, and laces. The understated ways of old money do not apply here. Greenwich, Connecticut, this is not.

For the families who take part, the cost of the event—the gown, the myriad parties—is not an issue. Nor is it discussed: "Would you ask me how many acres I own?" is Linda Gutierrez's practiced reply to any financial inquiry about the ball, equating it with the ultimate ranching faux pas. Over time, the price of a dress has escalated in direct proportion to the affluence of the ruling families: A beaded, velvet gown from the 1970s looks ornate until you see one from the post-NAFTA years, when the wealth of Laredo—and the inclination to show off that wealth—increased exponentially. Linda, whose stress-induced, *Exorcist*-like transformation during the event is a source of local legend, knows better than most how the richest people in town love to wear their hearts, their histories, and even their bankbooks, on their sleeves. "I want my daughter to steal the show," is the order one mother gave Linda. In Spanish, of course.

To understand Laredo's Martha Washington pageant, you have to understand the city's past. At best, Laredo is an acquired taste. It is one of those spots where it's best to develop an affinity for the sky because the land isn't much to look at. It is flat and scrubby, unsuitable for hardly anything but grazing, and the climate is hot and dry for most of the year. Laredo's appeal comes not from its topography but from its place on the map, its closeness to Mexico. Here, everyone is bilingual, and everyone switches languages with idiosyncratic abandon. ("I'm hearing about Shelby's party *todavia!*") A classic, bustling Mexican plaza is bordered by the lovely San Agustin Cathedral and the old La Posada hotel. Laredo's downtown streets smell of diesel exhaust and roasted *elotes*—ears of corn. Its old-fashioned awnings shield pedestrians in business suits as well as beggars in rags from the heartless sun.

Linda and Jennie's childhood had a freedom many would envy today. The girls spent their youth roaming *(Continued on page 105)*

For 30 years, designing dresses for debutantes has been a passion for Linda Gutierrez, far right. "They

think they're getting what they want," says Linda, "but I lead them to what I think is right."

Perfect as porcelain dolls, debutantes and their escorts are formally presented to 1,500 paying guests at

the Laredo Civic Center, in a ritual designed to preserve the established social order.

Floating on air, Alyssa Cigarroa waltzes at the ball on the arm of her escort Christopher Kimmel. The Society of Martha Washington, sponsor of the gala, urges debutantes to select a platonic partner; the ones chosen are often sons of society members. In past years, debs headed south of the border for a post-ball celebration (below), but not this year. Drug violence in Mexico kept the party closer to home.

their neighborhood at will, visiting the family ranch to ride horses, fish, or hunt, and attending party after party for baptisms, weddings, or graduations among the group of families and close friends who clustered in St. Peter's Plaza. "There were no paved streets," Linda says, and summers were so hot that maids sprayed the sisters' sheets with water before they got into bed at night.

In many ways, Laredo's upper class has changed little in more than 300 years: It is still dominated by preoccupations with lineage and class. Jennie Reed reminded me more than once that her family dates back to the 18th century. The city was founded in 1755 by a Spanish rancher who named Laredo after a town in Spain. Land on both sides of the Rio Grande was subsequently granted to people who were then citizens of New Spain, now Mexico. This world was socially stratified, with immigrants of Spanish descent at the top, and mestizos, mulattoes, and Indians below. Members of the lower classes were expected to address their betters as *don* and *doña*, partly out of respect and partly because they were beholden to them—the patrons were the only employers in town. They grew rich from ranching, running their small fiefdoms as they pleased.

After the U.S. defeated Mexico in 1848 in a bitter war for control of Texas, the boundary between the two countries shifted to the Rio Grande, and Laredo joined the Union. Those who wanted to remain Mexican citizens moved across the river to what became Nuevo Laredo—the new town. As commerce between the U.S. and Mexico increased, Laredo grew, drawing immigrants from Europe and other parts of the U.S. The area became even richer when oil and gas were discovered in the 1920s, and when the Mexican Revolution sent many from the wealthy, educated class scurrying for shelter on the U.S. side of the border. Laredo was a natural destination because, unlike in other Texas border cities, the early Spanish families had held on to their land and remained in power. They elected the officials, controlled the banks and businesses, and set the social tone. Anglo immigrants, if they wanted to advance, became "Mexicanized." "Josephs" became "Pepes," learned Spanish, and, if they were lucky, married into the Mexican gentry.

Community leaders created the first George Washington's birthday celebration as a way to gin up patriotism along the border during the Spanish-American War in 1898—to prove that Laredo's loyalty was to the U.S. With the addition of the Martha Washington Society in 1939, the Colonial Pageant and Ball became a way to connect the city's most eligible belles with its most eligible bachelors, cementing and maintaining dynastic alliances.

The result is a melting pot of Mexicans and Europeans. "We were a UN before there was a UN," Jennie Reed says. In a place like Manhattan or Boston, a debutante from a minority group is an anomaly. Here the girls' names resonate with the region's history: Treviño, Echavarría, Vela, and de Anda, as well as Leyendecker, Averill, and Bruni. The oldest Mexican and Anglo families intermarried so long ago that no one in their right minds would attempt to make ethnic distinctions. Laredo is a modern case study for those who worry that the constant influx of Mexican immigrants threatens to divide the country into two cultures, two peoples, two languages. If this city's history is any guide, assimilation is a given, especially among those fortunate enough to rise to the top.

Meanwhile the social stratification continues: The rich have stayed rich, and the poor—owing to a cheap and plentiful supply of labor across the border—have stayed poor. Today the poverty level of Webb County, where the city is situated, is 31 percent, double the statewide average. Per capita income in Laredo is only $11,000. It is for this reason that many find the extravagance of the Martha celebration disturbing, as it puts on display a kind of wealth that has preserved itself for centuries on the backs of the poor. "Does the oligarchy think about the plight of the immigrants?" asks María Eugenia Guerra, a former debutante who publishes an alternative newspaper called *LareDOS*. "Only when it inconveniences them." Not surprisingly, Jennie Reed disagrees: "Of course we are aware of the poor here. People in the society probably give away more money to charity than anybody. But if people who've worked hard want to spend their money this way, why not let them do it?"

Backstage on the night of the ball, the debutantes look like dolls too fine and pretty to take down from a shelf. They wear their hair piled in

curls atop their heads, with tiaras that match their gowns, their billowing skirts surrounding them like moats. The beads on their gowns sparkle under the lights, but the girls themselves barely move or speak, attended to by determined mothers and efficient makeup artists and hair stylists. They look beautiful but anxious, the way young women do when they are about to claim their places in society, even if the road was paved for them generations ago.

When Alyssa Cigarroa finally crossed the stage for her debut, in a lavender gown encrusted with beads and sequins she'd helped design, the crowd whooped, perhaps because they sensed she represented a change in the order of things. You wouldn't think the Cigarroa name would be an obstacle to becoming a Martha. To be a Cigarroa in South Texas is to be something like a Kennedy, only without the tragic curse. At the turn of the 20th century, the family had substantial wealth in Mexico, but that wealth—in mining—was seized during the revolution. After that, Alyssa's great-grandfather, Joaquin G. Cigarroa, Sr., worked his way through medical school, became an accomplished physician, and in 1937 settled with his wife in Laredo. The Cigarroas exhibit the values that have long contributed to the success of Mexico's most honorable families: Loyalty, service, and education take precedence over wealth for its own sake. Alyssa's grandmother, Barbara Cigarroa, still presides over lunches with her ten children, all of whom attended Ivy League schools (mostly Harvard) and became professionals (mostly doctors).

But even though Alyssa's father, Ricardo Cigarroa, a cardiologist, is perhaps the most important physician in town, Alyssa's desire to be a Martha was problematic. The story is convoluted, the truth impossible to discern. Whether it had to do with vague accusations of jealousy toward the family, a business feud among local doctors, or simply the Marthas' tradition of giving preference to members' daughters first (her mother, Lisa, was still on the waiting list), Alyssa's participation in the pageant was far from certain. That she was exemplary—as the Martha rules require—was not in question; it was just that the Marthas already had selected their debs for the year. It took a palace coup, engineered by a few members of the society, to get her chosen. After much politicking and a special vote, in the end the Marthas made room for Alyssa. "It was a revolution," is the way one member put it.

A revolution, of course, had already arrived—it had only taken old-line Laredo this long to notice. In the past, the city's wealthy Mexican-American residents had to create their own world because they weren't so welcome everywhere else. Though they traveled back and forth across the border to Mexico, no one visited Manhattan or Europe with the frequency they do now. It wasn't long ago that, even just a few miles up the road in San Antonio, people with Spanish surnames endured varying degrees of discrimination. The best law firms, the best hospitals, the San Antonio city council and mayor's office were all controlled by Anglo men. To succeed and prosper, it was best to stay home.

Those limitations have fallen away. The irony of Alyssa's deep desire to become a Martha is that a modern girl like her doesn't need the status anymore. Yes, weeks after the ball, her gown was still displayed on a mannequin in the Cigarroa family living room. And she enjoyed the parties given over the past year, at least five honoring each girl. These included a fete devoted to designer purses, one to designer shoes (Manolos were in evidence), a disco party, a Hollywood party, and, Alyssa's favorite, the one her grandmother gave her, in which the decor—tables, bows, lace—was a study in pink.

But, like the other debs, Alyssa has been raised to be a member of a much larger world. She attended Manhattan's Parsons School of Design and spent a summer studying art in Paris. These young women have résumés to rival students at Andover and Exeter. One pursued independent study at Cambridge University, and another participated in an MIT engineering program. One young woman plans to major in genetics, another to become a radiologist, another to work at ESPN. What these girls want, in becoming Marthas, is not to cement their places in Laredo, but to carry a bit of Laredo with them into futures that will be much more complicated than that of their mothers and grandmothers.

Laredo itself has become a much more complicated place in their lifetimes, as a bloody drug

No deb goes it alone: As Alyssa Cigarroa waves during Saturday's parade, her cousin Nicholas Martin tosses beads to the crowd. Family and friends lift a bedsheet with a hole cut in the middle (below) to help Alexzandra Gonzalez keep the grime of the streets off her gown. In recent years Laredo has become a center of international trade, and its economy is booming, yet nearly 30 percent of its families live below the poverty line.

Nestled atop her petticoat, Sara De Leon Ferrara catnaps before the big parade. "It was a year of training," she says. "It teaches you how to act in public, and it sticks with you." It also never ends. Next spring new debs will be chosen, and the pageant of dresses and dreams will begin anew.

war across the border threatens to spread north. The easy, open world of their childhoods is disappearing before their eyes. Where once the Marthas celebrated across the river after their debuts, the party this year was held in Laredo. "We don't go over there anymore" is a phrase heard frequently, and with good reason: Nuevo Laredo's annual homicide toll reached 46 shortly after the pageant. For Laredo residents, the possibility of getting caught in the cross fire is very real, as is the risk that their children could be kidnapped. "Three more die in N.L." was the headline in the *Laredo Morning Times* a few days before the ball.

Also in the headlines was a call to seal off the borders to keep out illegal immigrants, maybe even build a wall between the U.S. and Mexico, a move that would forever change Laredo. This is, after all, a town where the economy depends on immigrants who come to work and shop. "This place is so far removed from reality," says María Guerra. "If their housekeeper couldn't come, they would throw fits at what it would cost" to pay standard rather than border wages, she says. "But they bury their heads in the sand" when it comes to the current debate on immigration.

Sealing the border doesn't seem like such a bad idea to some, especially now that their daughters, as moneyed and well educated as any New England WASPs, no longer look to Mexico as their wider world but can move freely about the globe, with more opportunities than they could possibly explore in their lifetimes.

The usual parade honoring George Washington's birthday took place the day after the ball. The weather was bleak and cold, but the old families had set up shop in parking lots, barbecuing on flatbed trucks as they always did, while the hoi polloi sat on lawn chairs below, snacking on elotes and Domino's pizzas. It was a classic border scene, with the differences between rich and poor both obvious and ignored, as everyone begged for candy and plastic beads from the floats with the pretty girls in their jeweled gowns. But change was in the air, from both sides of the border, and these girls knew it, snuggling deep into their furs to ward off the chill. □

Tex-Mex Society Step into the Martha Washington ball via video, then meet more of the border's diverse population at **ngm.com/0611.**

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FIN IS A LIMB IS A WING

HOW EVOLUTION FASHIONED ITS MASTERWORKS

Eyes, wings, elaborate bodies—nature is filled with breathtakingly complex structures. Now scientists are learning how they emerged. From minute sea creatures to insects to humans, the same body-building genes are at work, revealing evolution's path from simple beginnings to intricate forms.

KING PENGUIN

A downy penguin chick has all the genetic makings for an adult's specialized feathers and flippers. Although the penguin's anatomy is unusual, the genes that build it are not.

APTENODYTES PATAGONICA, PHOTOGRAPHED AT WESTERN FOUNDATION OF VERTEBRATE ZOOLOGY

RHOMBODERA STALII

MANTID

The underside of a mantid reveals the complex structures that evolution added to its simpler ancestors: compound eyes, bristled limbs, two kinds of wings. Scientists are finding that all these structures have deep roots. The same genes that build them in a mantid are turning up —often doing different jobs—in less elaborate creatures.

BY CARL ZIMMER

PHOTOGRAPHS BY ROSAMOND PURCELL

The father of evolution was a nervous parent. Few things worried Charles Darwin more than the challenge of explaining how nature's most complex structures, such as the eye, came to be. "The eye to this day gives me a cold shudder," he wrote to a friend in 1860.

Today biologists are beginning to understand the origins of life's complexity—the exquisite optical mechanism of the eye, the masterly engineering of the arm, the architecture of a flower or a feather, the choreography that allows trillions of cells to cooperate in a single organism.

The fundamental answer is clear: In one way or another, all these wonders evolved. "The basic idea of evolution is so elegant, so beautiful, so simple," says Howard Berg, a Harvard researcher who has spent much of the past 40 years studying one of the humbler examples of nature's complexity, the spinning tail of common bacteria. "The idea is simply that you fiddle around and you change something and then you ask, Does it improve my survival or not? And if it doesn't, then those individuals die and that idea goes away. And if it does, then those individuals succeed, and you keep fiddling around, improving. It's an enormously powerful technique."

But nearly 150 years after Darwin first brought this elegant idea to the world's attention when he published *The Origin of Species*, the evolution of complex structures can still be hard to accept. Most of us can envision natural selection tweaking a simple trait—making an animal furrier, for example, or its neck longer. Yet it's harder to picture evolution producing a new complex organ, complete with all its precisely interlocking parts. Creationists claim that life is so complex that it could not have evolved. They often cite the virtuoso engineering of the bacterial tail, which resembles a tiny electric motor spinning a shaft, to argue that such complexity must be the direct product of "intelligent design" by a superior being.

The vast majority of biologists do not share this belief. Studying how complex structures came to be is one of the most exciting frontiers in evolutionary biology, with clues coming at remarkable speed.

Some have emerged from spectacular fossils that reveal the precursors of complex organs such as limbs or feathers. Others come from laboratories, where scientists are studying the genes that turn featureless embryos into mature organisms. By comparing the genes that build bodies in different species, they've found evidence that structures as seemingly different as the eyes of a fly and a human being actually have a shared heritage.

Scientists still have a long way to go in understanding the evolution of complexity, which isn't surprising since many of life's devices evolved hundreds of millions of years ago. Nevertheless, new discoveries are revealing the steps by which complex structures developed from simple beginnings. Through it all, scientists keep rediscovering a few key rules. One is that a complex structure can evolve through a series of simpler intermediates. Another is that nature is thrifty, modifying old genes for new uses and even reusing the same genes in new ways, to build something more elaborate.

Sean Carroll, a biologist at the University of Wisconsin–Madison, likens the body-building genes to construction workers. "If you walked past a construction site at 6 p.m. every day, you'd

say, Wow, it's a miracle—the building is building itself. But if you sat there all day and saw the workers and the tools, you'd understand how it was put together. We can now see the workers and the machinery. And the same machinery and workers can build any structure."

A limb, a feather, or a flower is a marvel, but not a miracle.

FROM ONE CELL TO TRILLIONS

In every human body roughly ten trillion cells—brainless units of life—come together to work as a unified whole. "It's a complex dance," says Nicole King, a biologist at the University of California, Berkeley, requiring organization and constant communication. And it began more than 600 million years ago when organisms containing just one cell gave rise to the first multicellular animals, the group that now includes creatures as diverse as sea sponges, beetles, and us. It turns out that some of those single-celled ancestors were already equipped for social life.

King studies some of our closest living single-celled relatives, known as choanoflagellates. Choanoflagellates are easy to find. Just scoop some water from a local creek or marsh, put a few drops under a microscope, and you may see the tadpole-shaped creatures flitting about. You can tell them apart from other protozoans by a distinctive collar at the base of their tail.

When King and her colleagues examined the proteins made by choanoflagellates, they found several that were thought to be unique to animals—molecules essential to maintaining a multicellular body. "It really blew our minds," says King. "What are these single-celled organisms doing with these proteins?"

Some of the proteins normally create what King calls "an armlock between cells," keeping animal cells from sticking together randomly. King and her colleagues are running experiments to figure out how choanoflagellates use these adhesive proteins—perhaps to snag bacteria for food. Others play a role in cell-to-cell communication. Choanoflagellates, which presumably have no need to talk to other cells, may use these proteins to sense changes in their environment.

The discoveries suggest that many of the tools necessary to build a multicellular body already existed in our single-celled ancestors. Evolution borrowed those tools for a new task: building bodies of increasing complexity.

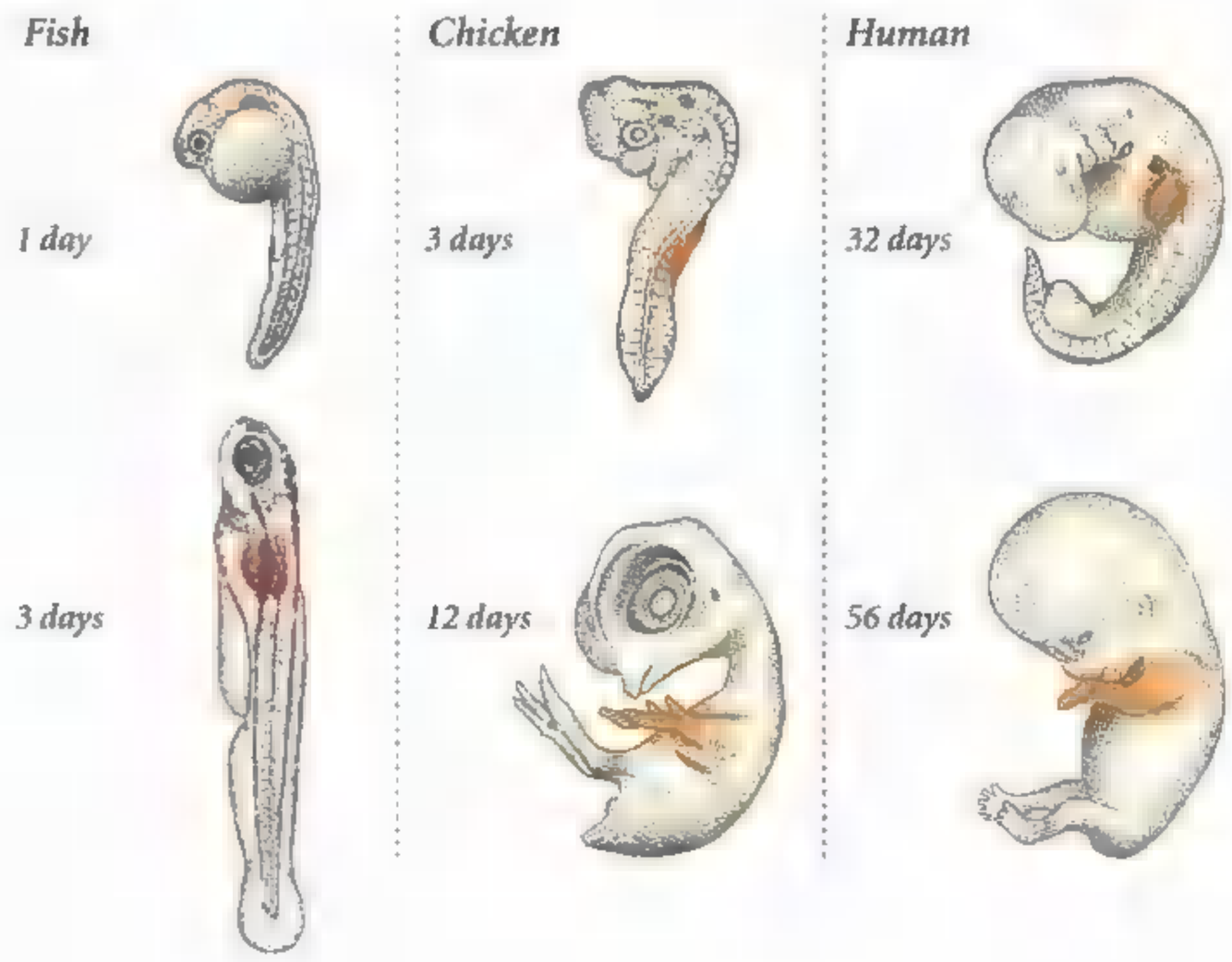
BLUEPRINTS FOR BODIES

A developing fly larva looks as featureless as a grain of rice. But it already bears a map of the complex creature it *(Continued on page 120)*

TAKING SHAPE

An animals com plex adult form emerges as its embryo develops. The early embryos of three different vertebrates—a fish, ▪ chicken, and a human—look much the same. But genes active in corresponding parts of the embryos (red) guide development down different paths, producing a fin, ▪ wing, or an arm. Evolution often reshapes organisms by tinkering with the genes that control development.

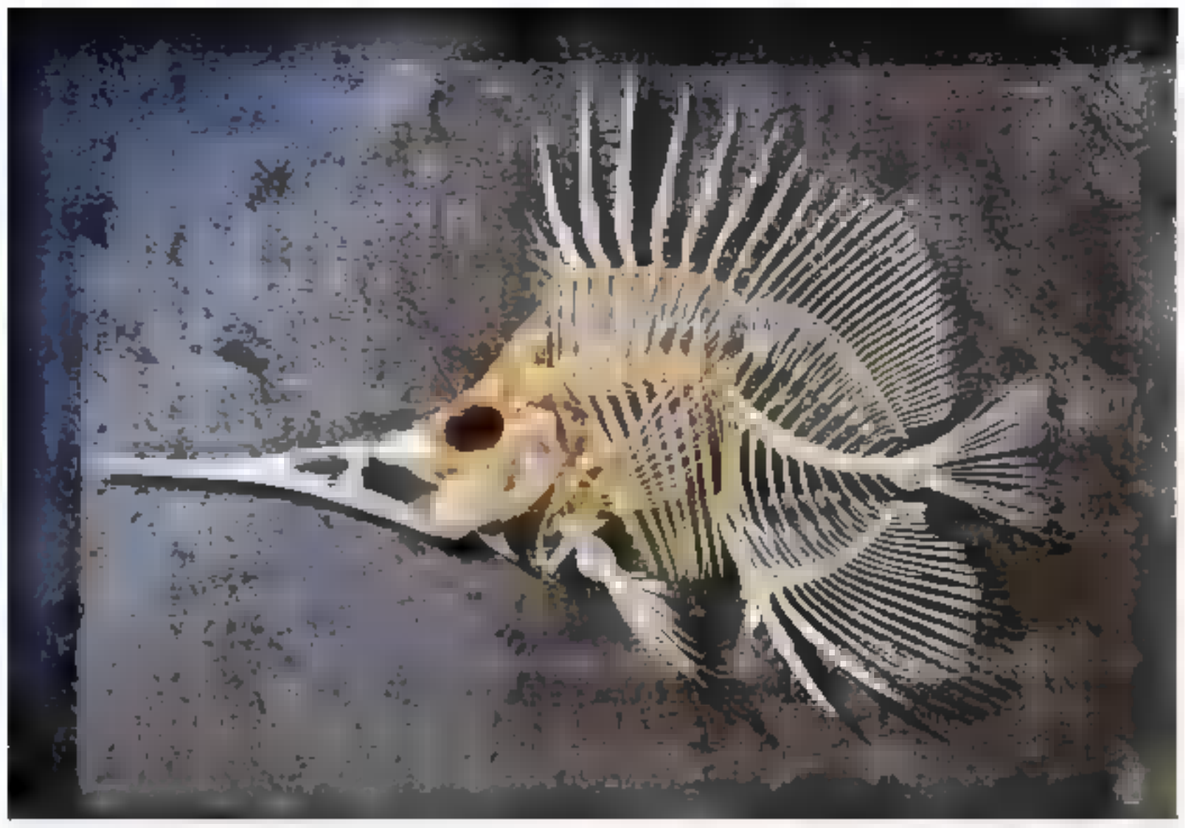
DRAWINGS NOT TO SCALE



ART BY JOHN BURGOYNE

REACHING FOR THE SKY

ANTROZOUS PALLIDUS, PHOTOGRAPHED AT NORTH CAROLINA STATE MUSEUM OF NATURAL SCIENCES



FORCIPIGER LONGIROSTRIS

LONGNOSE BUTTERFLYFISH

Old bones did new jobs as animals adapted to new environments. Some 400 million years ago so-called *Hox* genes became active at new times and places in developing embryos, reshaping fins into the earliest limbs. An ancient fish, distantly related to modern species like the butterflyfish (above), gave rise to ■ creature that could walk on land. (Midway came a fish with primitive fingers on its fins.) The shape-shifting continued in later land animals. A bat's wing is simply a retooled hand, with a thin membrane over elongated finger bones—the result of a tweak to a single limb-building gene in bats' mole-like ancestor. That tiny developmental change put a mammal in the sky.

PALLID BAT

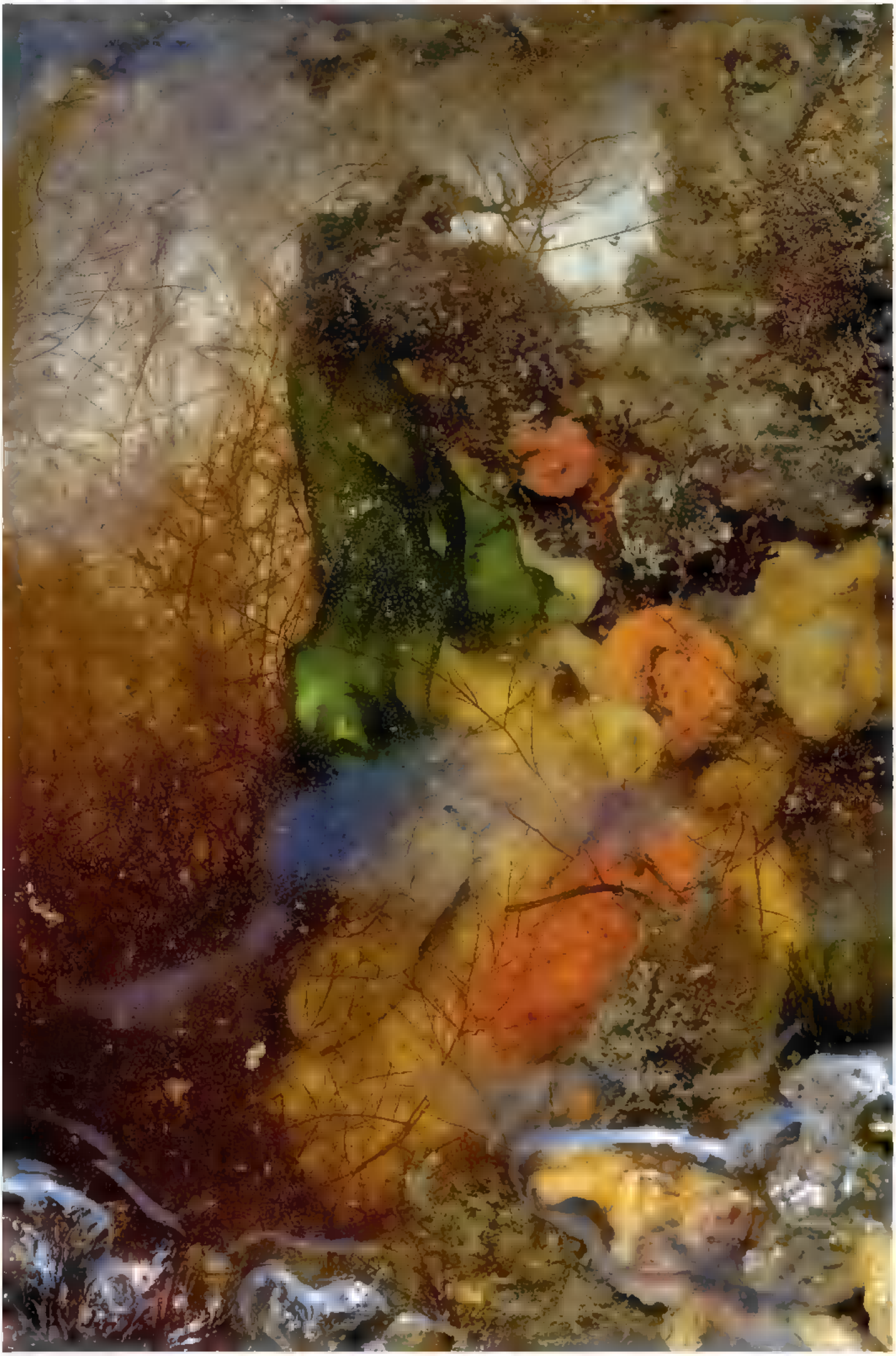
FROM ONE CELL TO MANY

ORDER CHOANOFLAGELLIDA: DRAWING BY WILLIAM SAVILLE-KENT

CHOANOFLAGELLATE

The animal kingdom dates back more than 600 million years, to when single-celled creatures —microscopic, water-sifting sacs propelled by undulating filaments—gave rise to many-celled animals like sponges and other marine invertebrates (yellow and orange masses, right). The fragile organisms that made this transition left no fossils, so scientists study choanoflagellates (illustrated above, with red food particles), perhaps the closest living one-celled relatives of animals. Even though they are solitary cells, choanoflagellates turn out to have genes that make proteins essential to multicellular life. This suggests that the one-celled ancestors of all animals were genetically equipped for "animalhood," although they put those tools to other uses.

SEA SPONGES & TUNICATES



SPONGE: *HALICHONDRIA BOWERBANKI;* TUNICATES: GENUS *BOTRYLLUS.* PHOTOGRAPHED AT MARINE BIOLOGICAL LABORATORY, WOODS HOLE

will become. Across the larva, different combinations of genes are active, marking it off into invisible compartments. These genes turn on other genes that give each compartment its shape and function: Some sprout legs, others wings, others antennae. An invisible anatomy becomes visible.

Flies aren't the only animals that build their bodies this way. Scientists have found that the genes responsible for laying out the fly's body plan have nearly identical counterparts in many other animals, ranging from crabs to earthworms to lampreys to us. The discovery came as a surprise, since these animals have such different-looking bodies. But now scientists generally agree that the common ancestor of all these animals—a wormlike creature that lived an estimated 570 million years ago—already had a basic set of body-plan genes. Its descendants then used those genes to build new kinds of bodies.

To appreciate how this tool kit can generate complexity, consider the velvet worm. The velvet worm creeps along the floors of tropical forests on nearly identical pad-shaped legs. It is, frankly, a boring little creature. Yet it is also the closest living relative to the single most diverse group of animals, the arthropods. Among arthropods, you can find a dizzying range of complex bodies, from butterflies to tarantulas, horseshoe crabs, ticks, and lobsters.

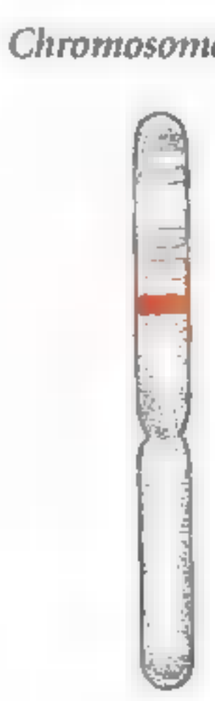
Scientists studying body-plan genes think arthropods started out much like velvet worms, using the same basic set of body-building genes to lay out their anatomy. Over time, copies of those genes began to be borrowed for new jobs. The invisible map of the arthropod body plan became more complex, with more compartments and new body parts sprouting from them.

Some compartments, for example, developed organs for breathing; later, in insects, those breathing organs evolved into wings. Early insect fossils preserve wings sprouting from many segments. Over time, insects shut off the wing-building genes in all but a few segments—or used some of the same genes to build new structures. Flies, for example, have just one pair of wings; a second pair has turned into club-shaped structures called halteres, which help flies stay balanced in flight.

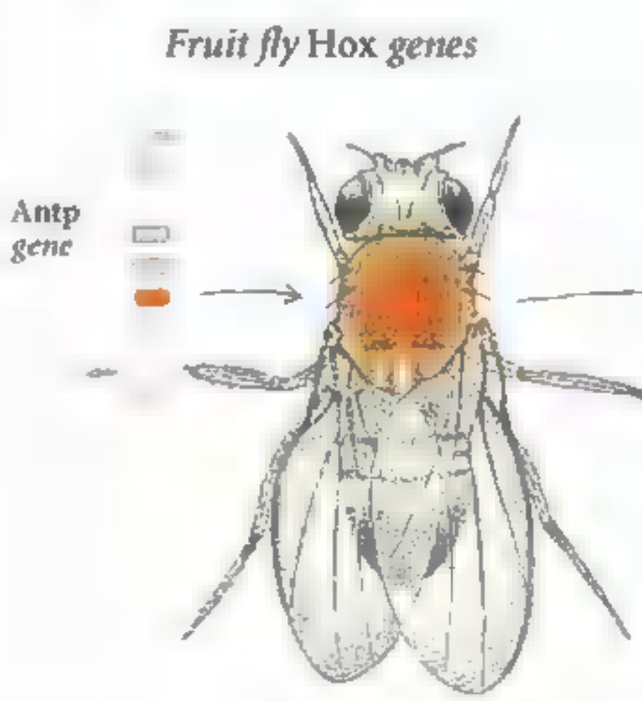
"The segments have all become different, the appendages have all become different, but the machinery for making appendages is the same," says Sean Carroll. "Evolution is a tinkerer, an improviser."

SAME MASTER GENES...

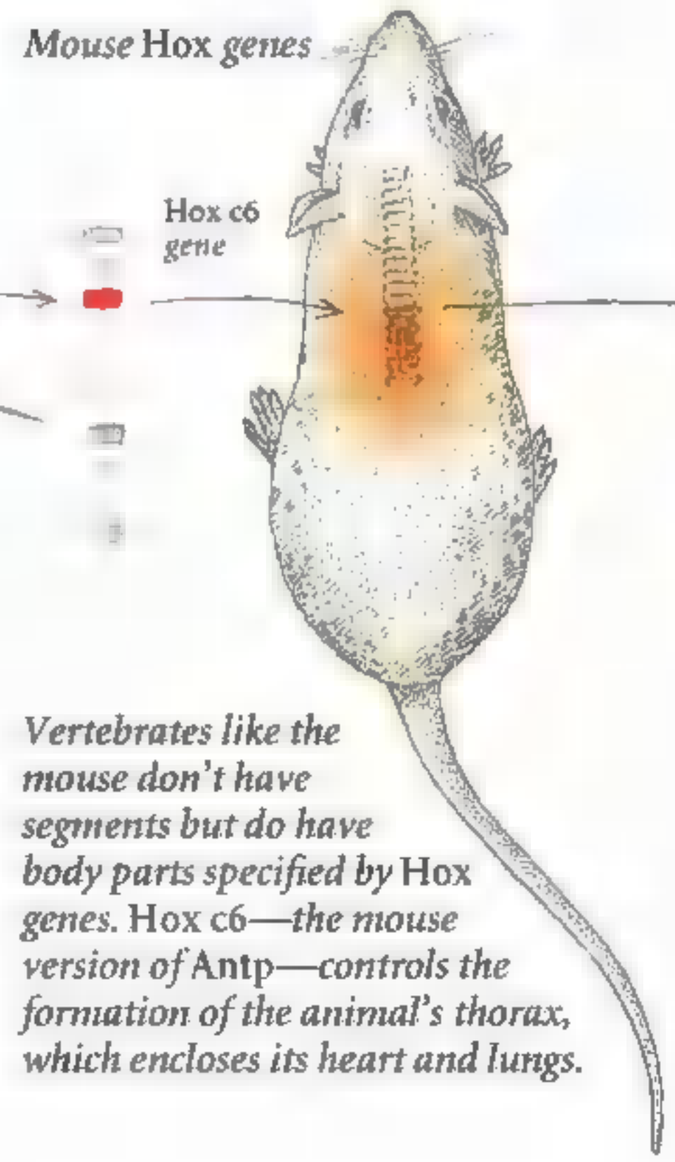
Hox genes act as master switches, turning on sets of other genes that guide the formation of distinct regions of an animal's body. Species from flies to mice to people all have inherited their _Hox_ genes from a common ancestor.



The Hox *genes, which are active along an animal's body in a particular order, from head to rear, are clustered along the animal's chromosomes in exactly the same order.*



Each of the fruit flys Hox *genes is active, either alone or in combination with others, in a part of the embryo that will become a distinct segment; the thorax (red), for example, is under the control of a* Hox *gene called* Antp.



Vertebrates like the mouse don't have segments but do have body parts specified by Hox *genes.* Hox c6*—the mouse version of* Antp*—controls the formation of the animal's thorax, which encloses its heart and lungs.*

SOURCE: SEAN B. CARROLL, UNIVERSITY OF WISCONSIN–MADISON
ART BY JOHN BURGOYNE

HOW WE GOT A HEAD

The human head is, inch for inch, the most complex part of our body. Not only does it contain our brain, but it also packs in most of our sense organs: eyes, ears, a nose, and a tongue. The intricate bones of the skull add to the head's complexity, from the cranium that keeps the brain safe to the jaws that allow us to eat. Thousands of variations on the theme exist—think of hammerhead sharks, of anteaters, of toucans.

All those heads become even more remarkable when you look at two simple sea creatures that are the closest living relatives of the vertebrates (animals with backbones). These humble organisms have no heads at all. But they have the makings of one in their genes.

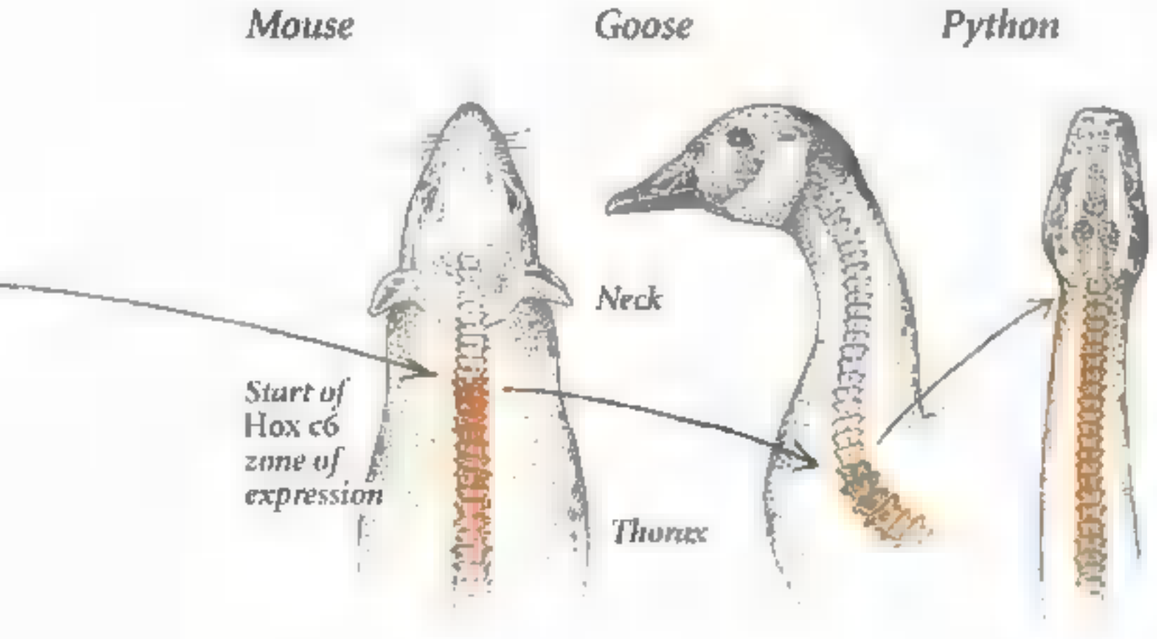
The larvacean, a tiny gelatinous tadpole, lives in a floating house it builds with its own mucus. Its nervous system, such as it is, is organized around a simple nerve cord running along its back. Even stranger is its cousin, the sea squirt. It starts out as a swimming larva, with a rodlike stiffener in its tail. When it matures, it drives its front end into the ocean floor, eats most of its nervous system, and turns its body into a basket for filtering food particles.

At first glance, these creatures seem unlikely to hold any clues to the origin of the vertebrate head. But a close look at the front tip of larvaceans and larval sea squirts reveals a small brainlike organ where a vertebrate would have a head. "There are 360 neural cells there. Compared with the vertebrate brain, that's nothing," says William Jeffery, a biologist at the University of Maryland. Yet scientists have seen a strikingly familiar pattern in how that tiny cluster of cells develops. Some of the same genes that build our own brains are at work there, and in roughly the same areas—front, middle, and rear.

Jeffery and his colleagues have also found that sea squirts have what appear to be primitive cousins of neural crest cells—the kind of cells that build much of the head in the developing embryos of vertebrates. Like our own neural crest cells, the sea squirt's emerge along the back of the developing embryo and migrate through the body. But instead of making a skull, neurons, and other parts of the head, they turn into pigment cells, adding brilliant colors to sea squirt bodies.

Over half a billion years ago our own headless ancestors may have resembled these modest creatures, already equipped with genes and cells that would later sculpt the faces and brains that make us human.

. . . MANY VARIATIONS

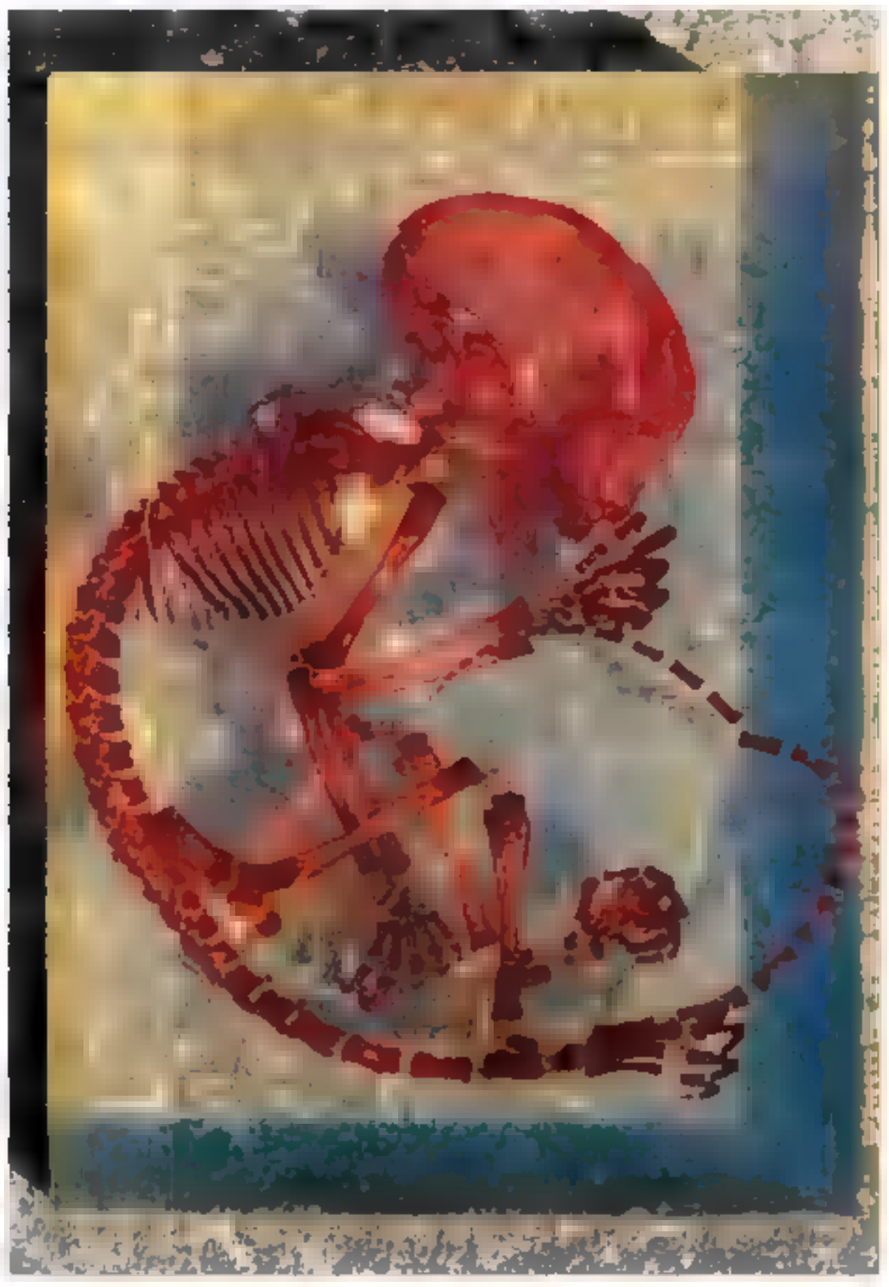


Body proportions can change depending on where particular Hox *genes are active. The same* Hox *gene,* Hox c6, *switches on at different points along the body. Since that gene marks the beginning of the thorax, different species end up with necks of varying lengths—a short neck in the mouse, a long one in the goose, and in the python, no neck at all.*

CATCHING THE LIGHT

Charles Darwin was well acquainted with the exquisite construction of the eye—the way the lens is perfectly positioned to focus light onto the retina, the way the iris adjusts the amount of light that enters the eye. An eye, it seemed, would be useless if it were anything less than perfect. In *The Origin of Species,* Darwin wrote that the idea of natural selection producing the eye "seems, I freely confess, absurd in the highest degree."

Yet the eye is actually far from perfect. The retina is so loosely attached to the back of the eye in humans that a sharp punch to the head may be enough to detach it. Its light-gathering cells point inward, toward the brain, not out toward the light. And the optic nerve starts out in front of the retina and then plunges through it to go to the brain. The *(Continued on page 126)*



GENUS *SAIMIRI*

SQUIRREL MONKEY

Animals as dissimilar as a squirrel monkey (stained skeleton, above) and softshell turtles start out more alike than they might appear. In most animals, *Hox* genes switch on early in the development of the embryo. Like a mapmaker's grid, the genes divide the blob-like embryo into compartments where specialized structures—ribs, vertebrae, limbs, eyes, the head—later take shape. "The monkey has a typical vertebrate body plan, with the addition of the long tail," says biologist Sean Carroll. "The turtle screams novelty because of its obvious adaptations—the flippers, the shell. But the animals share the same basic architecture, are built along the same plan. They're variations on ■ theme."

SPINY SOFTSHELL TURTLE

APALONE SPINIFERA, PHOTOGRAPHED AT NORTH CAROLINA STATE MUSEUM OF NATURAL SCIENCES

ORTHOPORUS ORNATUS. PHOTOGRAPHED AT NORTH CAROLINA STATE MUSEUM OF NATURAL SCIENCES

VERSATILE SEGMENTS

DESERT MILLIPEDES

They've got legs—lots of them. Arthropods, the hard-shelled group including some 80 percent of all living animals, from insects to crabs, have been well endowed with limbs for hundreds of millions of years. But while millipedes (left) have a chain of trunk segments with nearly identical pairs of walking legs, a horseshoe crab (below) is a Swiss army knife of jointed limbs—for walking, swimming, grasping, shredding, and defending. Yet the same ancient cluster of *Hox* genes governs the development of body segments in all arthropods. What type of limbs a segment acquires depends on which *Hox* gene is in control there, and on how evolution has reshaped the original unadorned parts to suit new needs.

LIMULUS POLYPHEMUS, PHOTOGRAPHED AT MARINE BIOLOGICAL LABORATORY, WOODS HOLE

HORSESHOE CRAB

place where the optic nerve burrows through the retina becomes the eye's blind spot. Evolution, with all its blunders, made the eye; Darwin himself had no doubt about that. But how?

A full answer has to account for not just our own eye, but all the eyes in the animal kingdom. Not long ago, the evidence suggested that the eyes in different kinds of animals—insects, cats, and octopuses, for example—must have evolved independently, much as wings evolved independently in birds and bats. After all, the differences between, say, a human eye and a fly's are profound. Unlike the human eye with its single lens and retina, the fly's is made up of thousands of tiny columns, each capturing a tiny fraction of the insect's field of vision. And while we vertebrates capture light with cells known as ciliary photoreceptors (for their hairlike projections, called cilia), insects and other invertebrates use rhabdomeric photoreceptors, cells with distinctive folds.

In recent years, however, these differences became less stark as scientists examined the genes that build photoreceptors. Insects and humans use the same genes to tell cells in their embryos to turn into photoreceptors. And both kinds of photoreceptors snag light with molecules known as opsins.

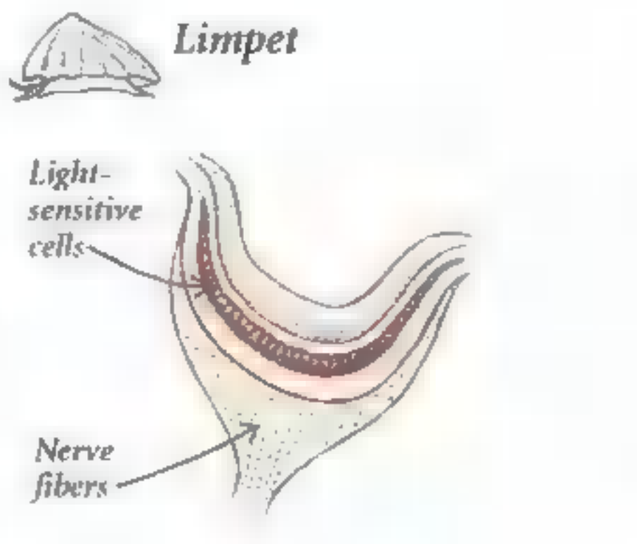
These links suggested that photoreceptors in flies, humans, and most other animals all evolved from a single type of cell that eventually split into two new cell types. If so, some animals might carry both types of photoreceptors. And in 2004, scientists showed that rag worms, aquatic relatives of earthworms, have rhabdomeric photoreceptors in their eyes and ciliary photoreceptors hidden in their tiny brain, where they appear to sense light to set the rag worm's internal clock.

With such discoveries, a new picture of eye evolution is emerging. The common ancestor of most animals had a basic tool kit of genes for building organs that could detect light. These earliest eyes were probably much like those found today in little gelatinous sea creatures like salps: just pits lined with photoreceptor cells, adequate to sense light and tell its direction. Yet they were the handiwork of the same genes that build our own eyes, and they relied on the same light-sensing opsins.

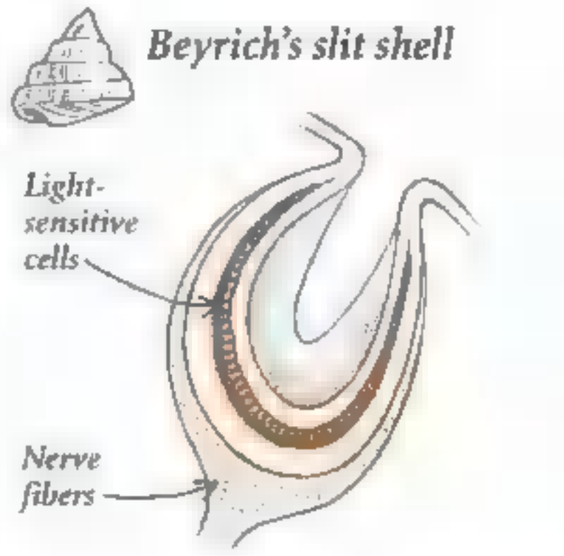
Evolution then used those basic genes to fashion more sophisticated eyes, which eventually acquired a lens for turning light into an image. The lens too did not appear out of nothing. Lenses are made of transparent proteins called crystallins, which can bend light "like protein glass," as one scientist says. And crystallins, it turns out, existed well before evolution put them to work in the eye. They were just doing other jobs.

Scientists have discovered one crystallin, for example, in the central nervous system of sea squirts. Instead of making a lens, it is part of a gravity-sensing organ. A mutation may have caused cells in the early vertebrate eye to make

Scientists once thought that eyes evolved independently many times. Research now indicates that some of the eye-building genes evolved only once in an ancient animal. Evolution brought other genes under the control of these primordial eye genes, and together they produced eyes from simple to complex, such as these eyes from different species of mollusks.



Protected by a layer of transparent cells, this basic eye cannot form an image but senses light with photosensitive cells.



A deeper eyecup provides more information about the direction of the light source, but creates no image.

the crystallin as well. There it turned out to do something new and extraordinarily useful: bring the world into focus.

FROM FINS TO LIMBS

Look at your arms holding this magazine. They are marvels of complexity, containing dozens of finely sculpted bones linked by tendons and muscles, supplied with blood by a mesh of arteries, controlled by an intricate network of neurons, and snugly wrapped in skin. Until about 380 million years ago, such limbs did not exist. Today they can be found not just on humans reading magazines, but also on bats flying out of Arizona caves, horses galloping across Mongolian steppes, moles burrowing through Connecticut gardens, and whales diving thousands of feet in the Pacific Ocean.

Fossils and embryos have provided a wealth of clues to the evolution of limbs. And they tell much the same story. "The limb was assembled over evolutionary time," says Neil Shubin, a paleontologist at the University of Chicago. "It didn't appear in one fell swoop."

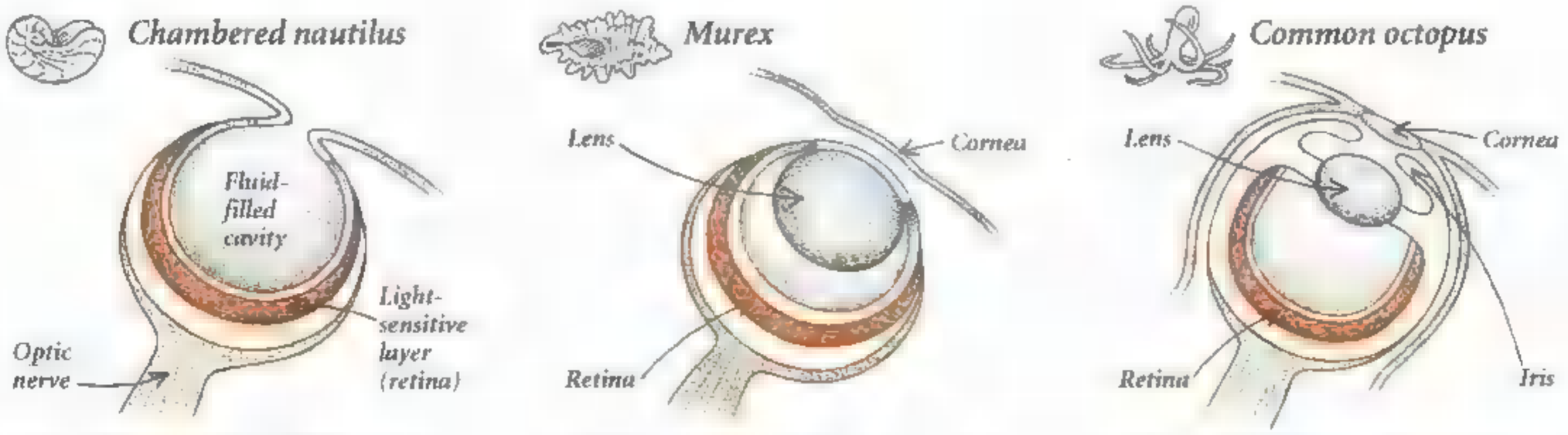
About 400 million years ago, a new lineage of fish called lobe-fins emerged, bearing the first glimmers of a limb. From the outside, lobe-fins looked like any other fish, with fins for swimming. But the bones inside their fins were larger and more heavily muscled than in other fish.

Over tens of millions of years, new lineages of lobe-fins evolved, and true limbs took shape. *Eusthenopteron,* a 385-million-year-old fish found in Canada, had fins that contained one large rod-shaped bone linked to a pair of smaller bones—the same pattern of long bones now found in our arms and legs. *Tiktaalik roseae,* a 375-million-year-old lobe-fin that Shubin and his colleagues recently discovered in northern Canada, added wrist and ankle bones. The scientists think *Tiktaalik* used its fins not only to swim but also to crawl across coastal wetlands.

"It's pushing up and pushing forward," says Shubin. "Could it walk? Could it rotate its shoulder and the rest? No. It's doing half the function, but it's half the function that suits the animal fully well."

By 365 million years ago, lobe-fins had given rise to vertebrates with true limbs, known as tetrapods, meaning four feet. These tetrapods even had toes, although they were still adapted to the water, retaining the gill bones of their ancestors and finned tails for swimming. Land walkers evolved later. And later still, tetrapods took the basic plan of the limb and adapted it to new functions—digging, paddling, and flying.

Laboratories are uncovering the genes responsible for building limbs and finding that once again, evolution used the tools already at hand: versions of the same genes that lay out animals' body plans. Once these genes mark off our bodies from head to tail, they become active in the tiny buds that become our arms and legs. Evolution must have *(Continued on page 134)*



A small gap at the top of the eye chamber acts as a pinhole pupil that focuses light on a rudimentary retina to form a dim image.

Fluid in a fully enclosed eye cavity functions as a primitive lens, focusing light on the retina to create a slightly sharper image.

Advanced vision is delivered by a complex eye equipped with protective cornea, colored iris, and focusing lens.

SOURCES: MICHAEL F. LAND ■■■ DAN-ERIC NILSSON, *ANIMAL EYES;* MONROE ■■ STRICKBERGER, *EVOLUTION.* ART BY JOHN BURGOYNE

MAKING EYES

AEQUIPECTEN IRRADIANS, PHOTOGRAPHED AT MARINE BIOLOGICAL LABORATORY, WOODS HOLE

SPHYRNA TIBURO, MOLA LANCEOLATA, PHOTOGRAPHED AT NORTH CAROLINA STATE MUSEUM OF NATURAL SCIENCES

BONNETHEAD
AND SHARPTAIL MOLA

A scallop's blue eyespots (left), which capture light with a mirrored surface, and the complex "camera-type" eye found in vertebrates from a shark and an ocean sunfish (above) to birds and humans evolved from the same basic light-catching device. Closely related genes govern early development in both kinds of eyes, a sign that they have a common ancestry. "Eye types are so different scientists thought they arose independently," more than 40 different times, says biologist Todd Oakley. "But it's like remodeling a house: You don't have to start from scratch; you just change certain elements." What allowed for those changes? "Duplication was part of it," he says. "If two genes evolve to do the same job, one is free to try something new."

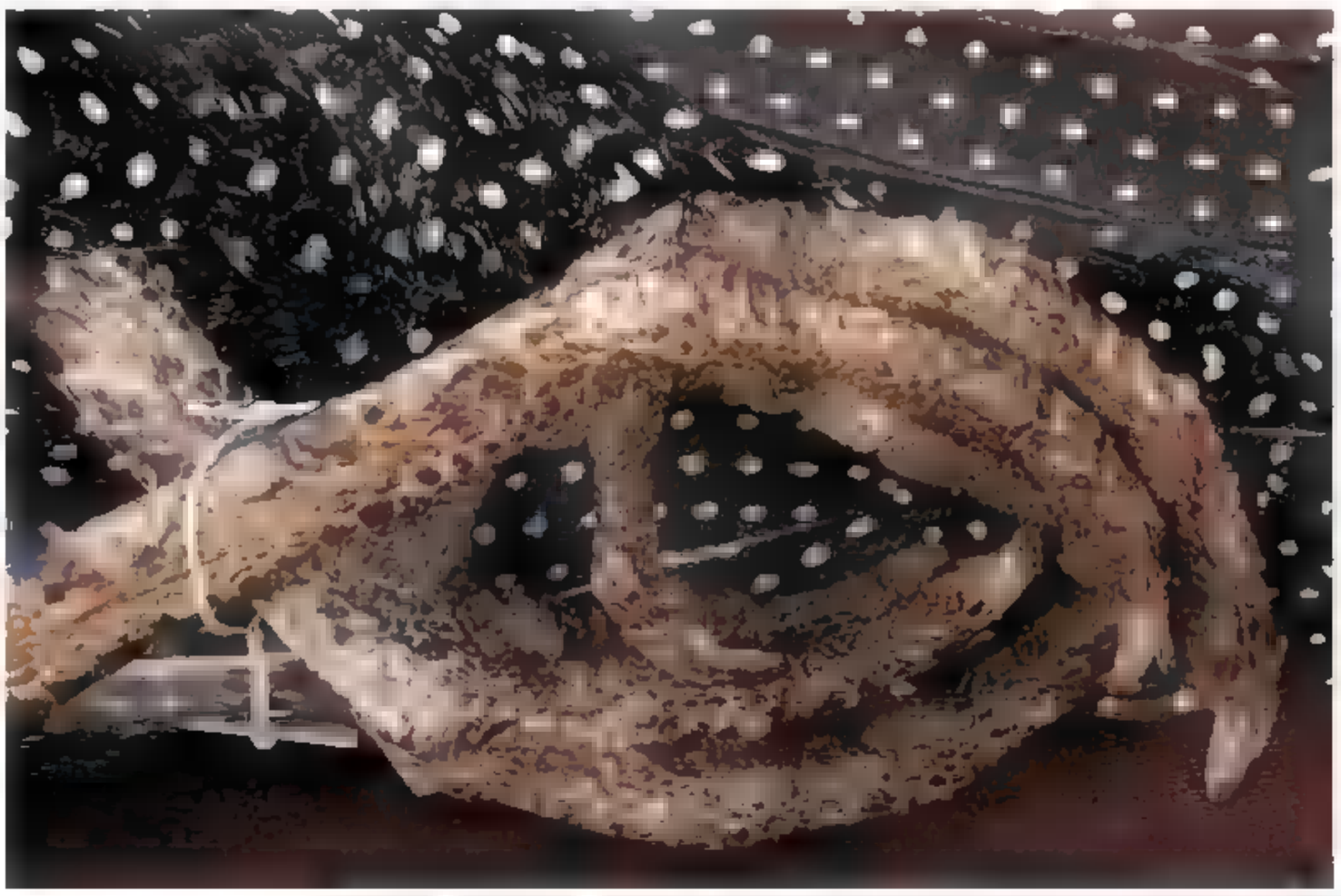
BAY SCALLOP

GOURA SCHEEPMAKERI, PHOTOGRAPHED AT WESTERN FOUNDATION OF VERTEBRATE ZOOLOGY

SCALED AND FEATHERED

SOUTHERN CROWNED PIGEON

The feathers of a crowned pigeon (left) and the scales on a guineafowl's foot (below) emerge from the same disks of cells, called placodes, in developing embryos. Similar genes control both processes. "Feathers didn't evolve directly from scales, as we once thought," says ornithologist Richard Prum, "but at a broad level, feathers and scales share origins." Among birds' dinosaur ancestors, evolution tinkered with the genetic signals that tell placodes to build scales—and the first feathers appeared. Since then feathers have acquired features to meet birds' unique needs: Zipper-like hooks lock the filaments of some feathers together to form smooth planes for flight, while fluffy, unzipped plumes are for show.



ACRYLLIUM VULTURINUM, PHOTOGRAPHED AT WESTERN FOUNDATION OF VERTEBRATE ZOOLOGY

VULTURINE GUINEAFOWL

CIONA INTESTINALIS, PHOTOGRAPHED AT [redacted] BIOLOGICAL LABORATORY, WOODS HOLE

SEA SQUIRT

"The head, with all its parts, is a vertebrate invention," but it didn't come out of nowhere, says biologist William Jeffery. A sea squirt (above)—a headless, filter-feeding creature that is one of our closest living invertebrate relatives—has cells similar to the neural crest cells that build cranial bones and teeth in a lion (right) and ourselves. In sea squirts these cells make the pigments coloring the collars around the animal's oral and anal openings, and they may also play a role in sensing its environment or protecting it from the sun. Scientists believe that the cells evolved hundreds of millions of years ago, before vertebrates and invertebrates parted ways.

LION

BUILDING A HEAD

PANTHERA LEO

borrowed these genes in early fish and reused them to build fins. Later, subtle shifts in the patterns formed by these genes caused these appendages to change shape into legs, arms, wings. Each transformation was profound. But, Shubin says, "you already had the machinery in place."

A FEATHER'S TALE

As a feat of engineering, it's hard to beat the flight feather of a bird. From a central vane sprout hundreds of filaments called barbs. The barbs in turn sprout other, smaller filaments, some with grooves and some with hooks that zip the barbs together like Velcro. They create a lightweight plane that can lift a bird into the sky. When birds pull their feathers apart to clean them, the barbs simply zip back together by themselves.

Feathers do other jobs too. The club-winged manakin, a sparrow-size bird from the jungles of Ecuador, can rattle its wing feathers so loudly they sing. Owl feathers are a kind of natural stealth technology, dampening sound so that the birds can surprise their prey. Fuzzy down feathers keep birds warm, while extravagantly curved feathers attract mates. Yet all these complex structures share their origins with prosaic reptile scales—a journey that Richard Prum, an ornithologist at Yale, is tracing.

The evolutionary link between feathers and scales is obvious on developing bird embryos. Disks of cells called placodes are scattered across the surface of the embryo. Some grow into scales, such as the ones that cover a chicken's legs. Others turn into feathers.

Prum's research indicates that feathers evolved in a series of steps, with old genes being borrowed each time for new uses. In reptile embryos specific genes mark off the front and back of each scale as it grows from a placode. In bird embryos, each feather begins as a tube growing from a placode, and the same front and back genes are at work in the tube. Some 150 million years ago, says Prum, those genes must have taken on this new role in dinosaurs, causing some to sprout the feathers and feather-like growths that recent fossil finds have revealed.

The appearance of branch-like barbs was the next step in feather evolution, Prum argues, and the development of a baby bird's downy feathers offers clues to how that happened. As a new feather tube grows, it divides into strips, which eventually peel away into barbs. And once again, only a little tinkering with genes may have been required to get the tube to split. Prum has shown that the same genes that mark the front and back of reptile scales and feather tubes also mark the points around the tube where it will split.

Later, birds evolved the ability to turn these fluffy feathers into feathers with vanes, and then to lock the barbs together to make flight feathers, all with slight genetic changes that Prum is tracing. And by tweaking the growth of different parts of the feather, birds evolved special plumage for hunting, swimming, courting, and other activities, Prum says. "All the kinds of stuff that the bird needs throughout its life, it can generate with the same basic information."

EARLY BLOOMING

Like many other Victorian gentlemen, Charles Darwin was fond of plants. He packed his hothouses with sundews, cowslips, and Venus flytraps. He had exotic orchids shipped from the tropics. And yet, as he wrote to a friend in 1879, flowers were for him "an abominable mystery."

Darwin was referring to the sudden, unheralded emergence of flowers in the fossil record. Making the mystery all the more abominable was the exquisite complexity of flowers. Typical flowers have whorls of petals and petal-shaped sepals surrounding the plant's male and female sex organs. Many also produce brilliant pigments and sweet nectars to lure insects, which ferry pollen from flower to flower.

Today the mystery of flowers is less abominable, although big questions still remain. The first flowers must have evolved after the ancestors of flowering plants split from their closest living relatives, the gymnosperms—including pines and other conifers, cycads, and ginkgoes—which produce seeds but not flowers.

Some of the most important clues to this transition come from the genes active each time a plant blossoms. It turns out that before a flower takes shape, sets of genes mark out an invisible map at the tip of the stem—the

same kind of map found on animal embryos.

The genes divide the tip into concentric rings. "It's like a stack of doughnuts on top of the stem," says Vivian Irish of Yale. Guided by the genes, cells in each ring develop into different flower parts—sepals in the outer ring, for example, and sex organs in the innermost rings.

As is so often the case with complexity, the genes that build flowers are older than the flowers themselves. Gymnosperms turn out to carry flower-building genes even though they don't make flowers. Scientists have yet to determine what those genes do in gymnosperms, but their presence indicates that these genes probably existed in the common ancestor of gymnosperms and flowering plants.

In the flowering plant lineage those genes were borrowed to map out the structure of the flower. The first flowers were simple. But over time, the genes were duplicated accidentally, freeing one copy to take on a new role in flower development. Flowers grew more complex, and some of their parts gained new functions, such as luring insects with bright colors and fragrance.

This flexibility may help explain the success of flowering plants. Some 250,000 known species of flowering plants exist today. Gymnosperms, their flowerless relatives, are stuck at just over 800.

COMPLEXITY IN MINIATURE

Some of life's most marvelous structures are its smallest: the minute clockwork of molecules that make cells tick. *E. coli,* a bacterium found in the gut, swims with a tiny spinning tail made up of several dozen different proteins, all working together. Doubters of evolution are fond of pointing out that the flagellum, as this tail is called, needs every one of its parts to function. They argue that it could not have evolved bit by bit; it must have been created in its present form.

But by comparing the flagellar proteins to those in other bacterial structures, Mark Pallen of the University of Birmingham in England and his colleagues have found clues to how this intricate mechanism was assembled from simpler parts. For example, *E. coli* builds its flagellum with a kind of pump that squirts out proteins. The pump is nearly identical, protein for protein, to another pump found on many disease-causing bacteria, which use it not for building a tail but for priming a molecular syringe that injects toxins into host cells. The similarity is, in Pallen's words, "an echo of history, because they have a common ancestor."

Scientists have discovered enough of these echoes to envision how *E. coli*'s flagellum could have evolved. Pallen proposes that its pieces—all of which have counterparts in today's microbes—came together step-by-step over millions of years. It all started with a pump-and-syringe assembly like those found on pathogens. In time, the syringe acquired a long needle, then a flexible hook at its base. Eventually it was linked to a power source: another kind of pump found in the cell membranes of many bacteria. Once the structure had a motor that could make it spin, the needle turned into a propeller, and microbes had new mobility.

Whether or not that's the full story, there is plenty of other evidence that natural selection has been at work on the flagellum. Biologists have identified scores of different kinds of flagella in various strains of bacteria. Some are thick and some are thin; some are mounted on the end of the cell and some on the side; some are powered by sodium ions and some by hydrogen ions. It's just the kind of variation that natural selection is expected to produce as it tailors a structure to the needs of different organisms.

Darwin also argued that complex features can decay over time. Ostriches are descended from flying birds, for example, but their wings became useless as they evolved into full-time runners. It turns out that microbial tails can become vestigial as well. Although *E. coli* is believed to make only one kind of tail, it also carries the remnants of genes for a second type. "You expect to see the baggage of history," says Pallen.

Evolution, ruthless and practical, is equally capable of building the most wonderful structures and tossing them aside when they're no longer needed. □

Wonderful Life See more of evolution's intricate designs in a photo gallery, explore related links, and join ■ forum on human origins at **ngm.com/0611.**

Mating red-eyed tree frogs will add new life to a population besieged by predators.

Born on the run, hiding in plain sight

It's a Frog's Life

A tree frog's nictitating membrane, an extra eyelid, veils the eye without blocking sight. The

tiger-stripe design may also let a frog keep watch while concealing its vivid eyes from predators.

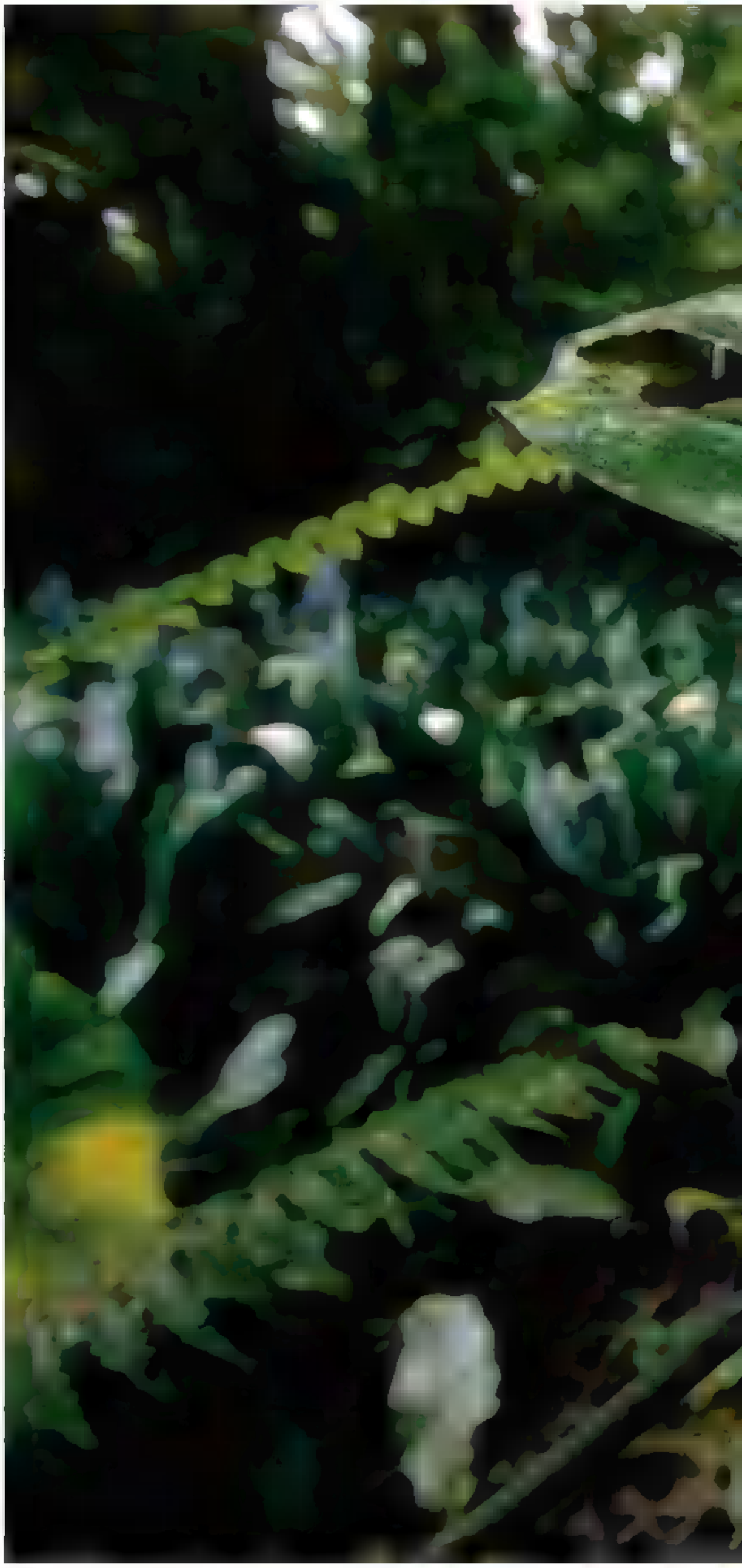
By Jennifer S. Holland
NATIONAL GEOGRAPHIC SENIOR WRITER

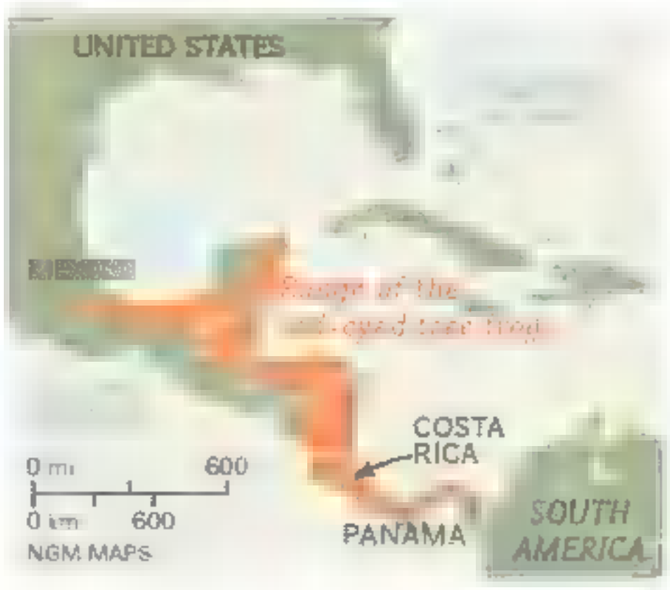
Photographs by Christian Ziegler

They look like spilled candy, these tropical frogs with the red eyes and outsize orange feet. You'll be tempted to scoop one up and cup it in your hands. But let it go, because the red-eyed tree frog's life is an extraordinary journey.

It's the wet season, and a Central American rain forest hums with life. *Chock, chock, chock,* the love song of *Agalychnis callidryas* plays in overlapping notes around a pond. The frogs have left their tree canopy home to mate; males wrestle one another for territory, then pile on females, vying to fertilize their eggs. The females wander all night, bush to bush, leaf to leaf, stacked with one or even two suitors, in search of good spots over water for spreading their jelly-encased eggs. The next morning, hundreds of shiny clutches, each housing up to a hundred frogs-to-be, smudge the landscape —and attract predators.

A. callidryas eggs, which are laid throughout the rainy season, make easy prey. They hang exposed for six days in sacs that shimmy wetly at the slightest disturbance. Snakes attack entire clutches, and wasps pluck out and carry off single squirming embryos. In all, the two predators take well over half the eggs. Related frog species such as *A. saltator* may be less vulnerable because while they breed less often, they breed explosively, producing so many eggs at





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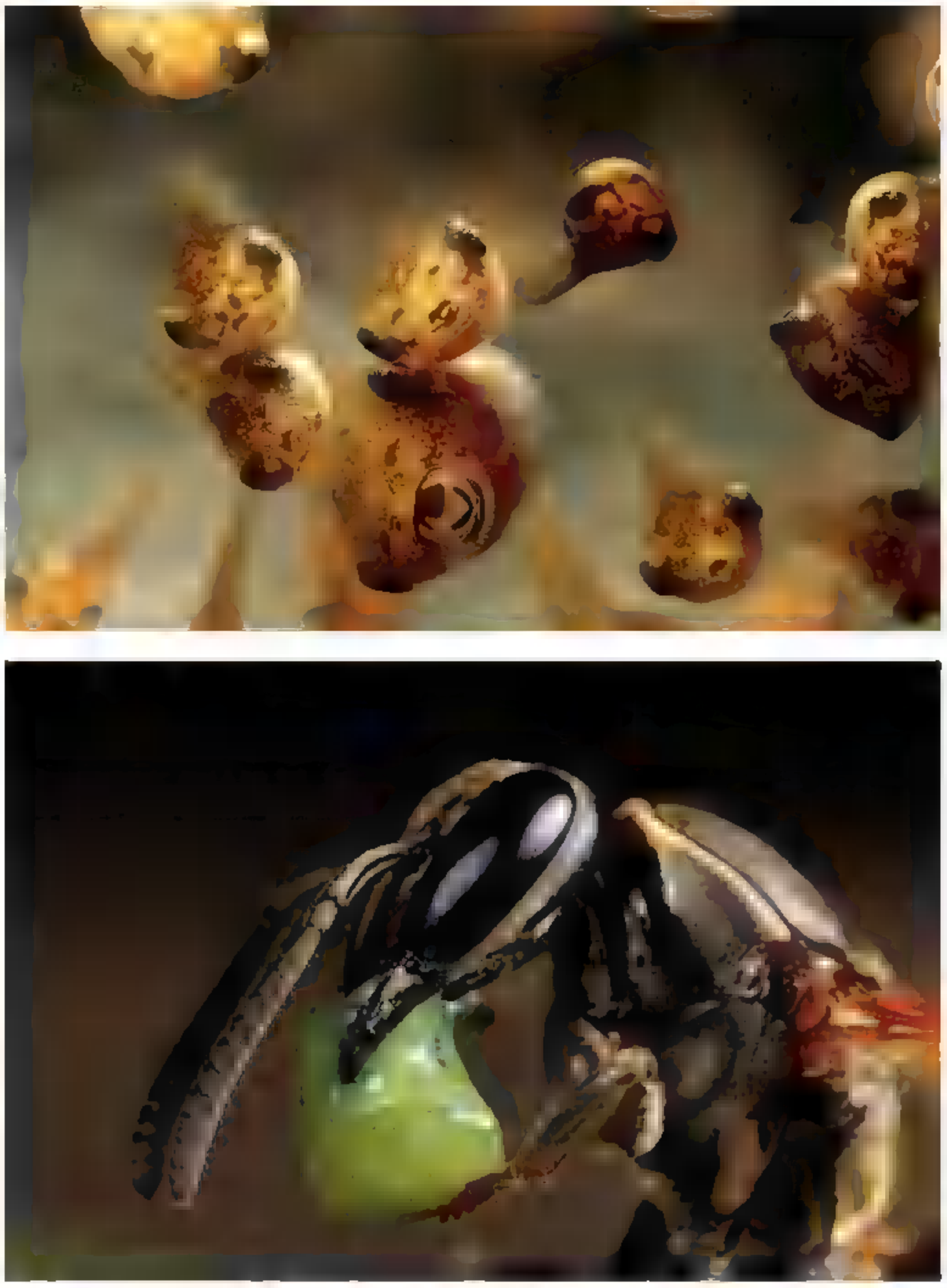
On clown feet, *Agalychnis callidryas* stalks through its rain forest habitat in Costa Rica. The wild body patterns and colors vary geographically and between species, and like the bold eyes, could serve to startle predators as a frog flees.

"It's a scramble competition," says biologist Karen Warkentin of the mating parties of *A. saltator,*

a kin to *A. callidryas*. In the mayhem, males strive to piggyback onto egg-laying females.



Gorging on eggs, a cat-eyed snake (right) and a wasp (left, below), shake up nearby embryos, prompting them to hatch up to two days early. It's a frantic struggle out of the egg membrane and into water, but when a clutch is assaulted, some 80 percent of tadpoles (left) make the escape.

once that snakes and wasps barely make a dent.

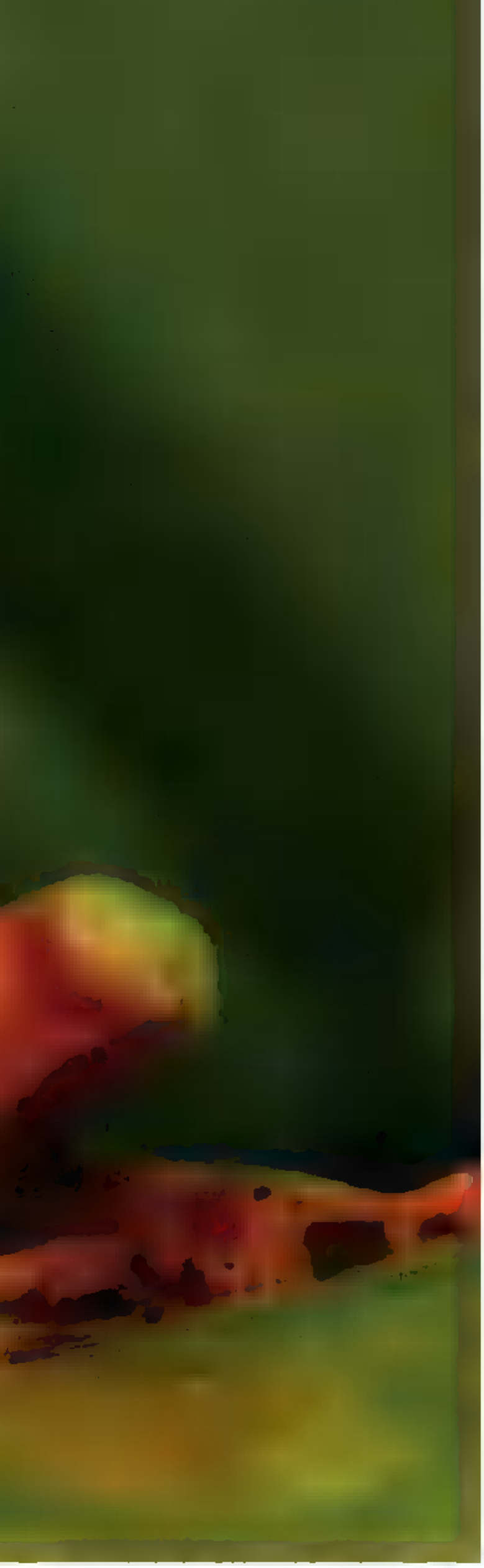
But here's the elegant twist: *A. callidryas* embryos have evolved a safety net. If attacked, they can hatch within seconds, and up to two days prematurely, dropping to safety in the water below. And what most astonishes scientists is that the animals can distinguish a predator's attack from a shiver of wind or a wash of rain through the vibrations in the egg jelly. Embryos judge whether the threat is real by how often the vibrations come and how long they last. The eggs even react differently to different assailants.

Boston University biologist Karen Warkentin, working at the Smithsonian Tropical Research Institute in Panama, assaulted tree frog eggs with various forces to study their reactions. "We had a window on the embryos' minds and could ask them questions: Is this scary? Can you discriminate between this and that?" Fantastically, they could. It turns out that when a snake bites into a gooey mass, all the embryos try to wiggle free. A wasp's more focused attack prompts only neighboring eggs to hatch. And a rainstorm triggers nothing at all.

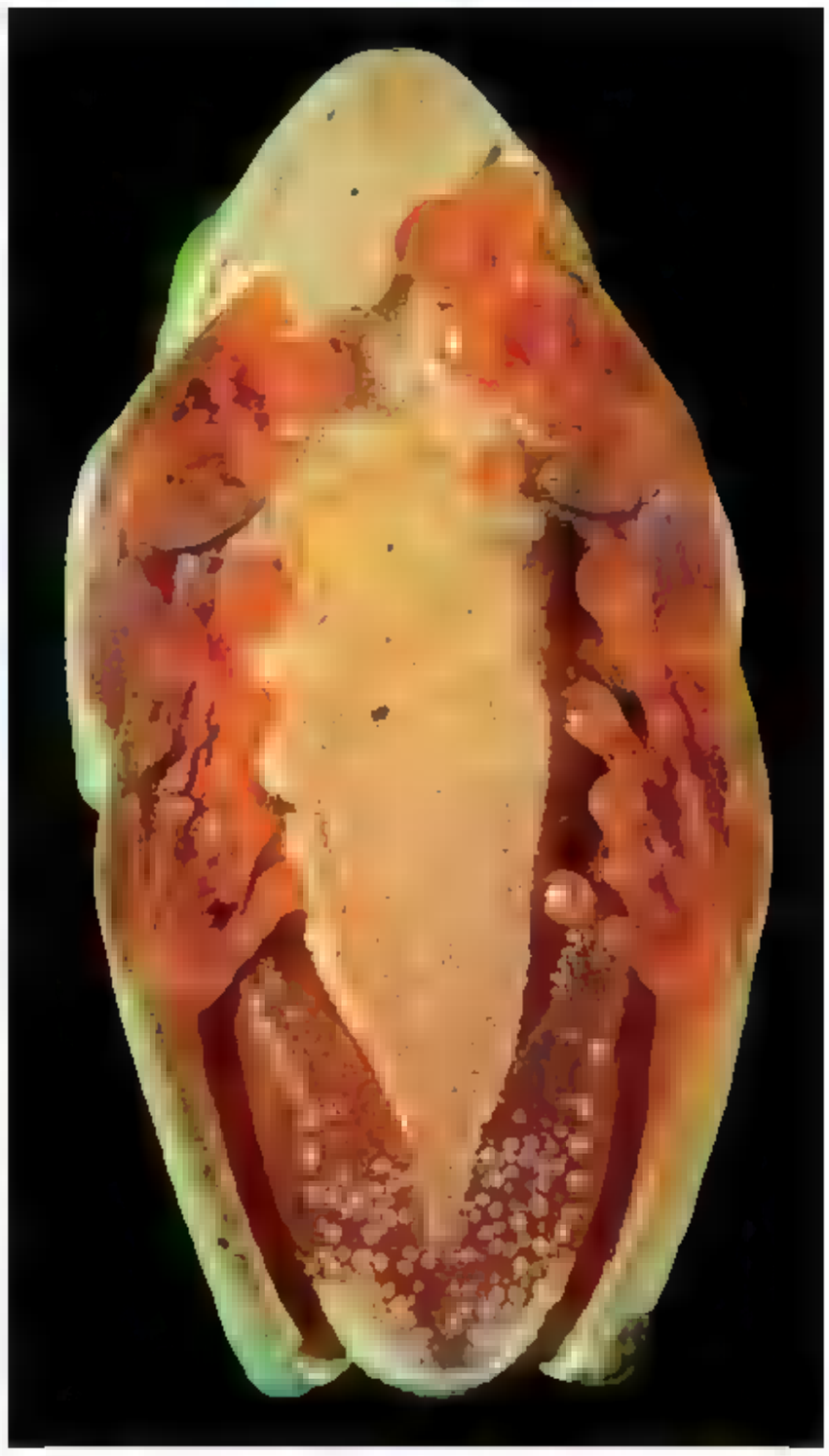
All the *Agalychnis* species Warkentin and collaborator Ivan Gomez-Mestre have studied so far also hatch early if the eggs are submerged —as when an egg-heavy leaf falls into a pond— which can drown the embryos. Reacting to a lack of oxygen "is clearly an ancient survival response that's preserved in many egg-laying vertebrates,"

says Gomez-Mestre. But premature hatching under predatory threat wasn't known until Warkentin observed it. Now, other scientists report the behavior in various amphibians, a spider, and a fish, suggesting that the ability has evolved independently many times. But how the embryos sense danger and make their Houdini-like escape is still a mystery.

What happens to the embryos after the fall? No pocket of rain forest is benign, and having squeezed from egg membrane into waiting pond and dropped to the bottom, the premature tadpoles face new threats: invertebrates such as shrimp and giant water bugs, and, at some sites, fish. But many endure and complete their development, in coming weeks sprouting legs and growing the lung power they'll need on land. A gantlet of new predators awaits them there—large spiders, birds, snakes—but the fittest survive yet again to master another novel environment, climbing to safety in the tall trees.



Forever at risk, an insect-fed adolescent (left, with grasshopper) can dehydrate or be eaten. By tucking in their bright feet (right, on glass, and below), tree frogs conserve water and camouflage themselves. Says Warkentin, "From above, with the toe pads and other colorful bits put away, all you see is green."



Creative biology aside, the red-eyed tree frog, of the thousands of known frog species, is singular in charm. Nearly 200 million years of evolution has crafted a creature that grows vibrant and bold, a beautiful tree nymph—the literal meaning of the Latin *callidryas*—but also a clown content to walk across another's head, foot to eyeball. With a broad smile that opens into a night predator's maw, it tags insects with a sticky lick and swallows them whole. Blinking its big eyes helps force the prey down. Toes tipped with grippy pads fan from those gangly limbs; the reach is expansive, and each step seems to follow a long, hard thought. As a frog sleeps away the midday heat, its hunkered-down form hardly seems like flesh—bulbous eyes cloaked, glistening body pressed to leaf, a dewdrop vanished against the green. □

Flashy Frogs Find more images in a Web-exclusive gallery. Then download these colorful frogs to your desktop as wallpaper at **ngm.com/0611**.

MEET THE DIKIKA BABY, A THREE-YEAR-OLD FROM THE DAWN OF HUMANITY. HER DISCOVERY HOLDS CLUES TO THE ORIGIN OF CHILDHOOD

A model of the ancient youngster is shown life-size at right. Artists created it from ■ skull (above) and other bones found in Ethiopia.

MODEL BY KENNIS & KENNIS. PHOTOGRAPH BY SARAH LEEN AND REBECCA HALE, BOTH NGS STAFF

By Christopher P. Sloan SENIOR EDITOR
Photographs by Kenneth Garrett
Art by Greg Harlin

Zeresenay Alemseged has two babies. One is Alula, who spends most of his time in his mother's arms in a cozy bungalow in Addis Ababa, Ethiopia's capital. The other is a little girl of three, who spent 3.3 million years locked in sandstone, until the Ethiopian scientist and his team discovered her remains and painstakingly teased them out of the rock. It was a long, slow second birth for a baby from the dawn of humanity.

Until now all fossils of babies this ancient could have fit in a diaper. This new arrival is not only the most complete ancient infant but arguably the best fossil of her species, *Australopithecus afarensis.* That's the same species as the superstar fossil called Lucy, a 3.2-million-year-old adult female found in 1974. Unlike Lucy, the baby has fingers, a foot, and a complete torso. "But the most impressive difference between them," says Zeresenay (Ethiopians' first names are their formal ones), "is that this baby has a face."

No bigger than a cantaloupe, the little bundle of bones may also bear witness to a key event in the evolution of hominins, as humans and their ancestors are known: the beginning of our long, dependent childhood, when we grow our large brains. "Outside of its completeness, the major importance of this find is the light it will shed on how this species lived and grew," says Bill Kimbel, an expert on *A. afarensis* and a member of the study team. "Now we can begin to read its biography."

It is a curious coincidence that the world's oldest baby, who died while still of nursing age, lived her short life in a region named Dikika—"nipple" in the local Afar language, after a distinctly shaped hill. The hill is just across the winding Awash River from Hadar, the site in Ethiopia's Rift Valley where Lucy and the fossils of many other hominins have been found. The region is plagued by extreme heat, flash floods, malaria, and occasional shoot-outs between

The Dikika baby (far left) joins two specimens found earlier, a male, AL 444-2 (larger skeleton), and a female dubbed Lucy, to create a portrait of the species *Australopithecus afarensis*. With much of her skeleton recovered, the Dikika baby is the most complete specimen this ancient and offers new clues about how this human ancestor blurred the line between ape and human. For example, the shape of her shoulders resembles a young gorilla's, suggesting she could climb trees. But the angle of her femur from knee to hip is close to that of a modern human, implying she walked efficiently on two legs. Some details of her skeleton are speculative, because not all the bones have been removed from surrounding rock.

Present

Homo sapiens

1

Genus *Homo*

2

3

A. afarensis

- AL 444-2, male
- Lucy, female
- Dikika baby

Australopiths

4

5

6

Early hominins

7 million years ago

NGM ART

HEAT, MALARIA, LIONS, AND SHOOT-OUTS PLAGUE THIS HARSH REGION

Ethiopia's badlands dwarf the dig team, returning from the Dikika site. Tectonic shifts and erosion have bared sediments laid down millions of years ago, when *A. afarensis* and other human ancestors inhabited the once lush terrain. Lucy's remains were found just six miles away.

rival ethnic groups, not to mention lions, hyenas, and other uninvited nocturnal guests. It is one of the most difficult places on Earth to hunt for fossils—and one of the most fruitful.

For decades the low-lying northern end of Africa's Great Rift Valley, the Afar depression, has been the domain of foreign-led expeditions. Zeresenay, one of a new generation of Ethiopian paleoanthropologists, changed that in 1999 when he led a band of Ethiopian fossil hunters into the Afar badlands.

By December 2000, the search had turned up plenty of fossil mammals, such as elephants, hippopotamuses, rhinoceroses, and antelopes, but no hominins. Yet Zeresenay, who is based at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, knew his team was looking in the right place. These animals would have thrived in the gallery forest that flanked the ancestral Awash River. Early hominins would have lived in these shady woodlands as well.

The prehistoric forests of Dikika are long gone, and there was no shade on December 10, when team members forced themselves out into the hot sun to look again. Tilahun Gebreselassie was the first to see the Dikika baby's tiny face peering out from a dusty slope. It was no bigger than a monkey's, but a smooth brow and short canine teeth told Zeresenay right away that this was a small hominin. His team had struck fossil gold, for not only was the baby's skull in perfect shape, but tucked beneath the head in a hard ball of sandstone were many bones of the upper body as well. "This is something you find once in a lifetime," Zeresenay says.

He doesn't know how the Dikika baby died, but the river must have rapidly buried the body in pebbles and sand, protecting it from scavengers and weather before gradually hardening into rock. While most hominin fossils have to be glued together from hundreds of fragments, Zeresenay faced the opposite challenge. He had to etch away hard sandstone with a dentist's drill, navigating between tiny vertebrae and ribs so anatomical details could be seen. "I cleaned it grain by grain," he says. "You don't want to destroy it by rushing." The task has taken five years so far.

The payoff: details rarely seen in a fossil australopith, among them a full set of both milk

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Zeresenay Alemseged, leader of the Dikika Research Project, holds his trowel over the spot where the Dikika baby's skull was found in 2000. His team has spent five field seasons picking over the slope and sifting the soil to find bones that had been washed downhill.

Like a modern child, the Dikika baby may have relied on her mother to hold her (artist's impression, left). As Zeresenay coaxed the bones out of the rock, classic ape traits emerged, notably the elongated face (top right) and shoulders suited to climbing. Yet a partial knee and a nearly complete leg and foot (bottom right) indicate bipedalism—walking on two legs. "I see *A. afarensis* as foraging bipeds but climbing trees when necessary, especially when they were little," Zeresenay says. At some point, bipedal human ancestors lost the opposable big toes of chimpanzees and other apes, which baby chimps use to grip their mothers with four limbs. "This allows a mother to forage, escape from danger, and travel, while keeping the baby close," says Rebecca Gullott, a chimp expert who supervises the Maryland Zoo's mammal collection. The Dikika baby's big toe—the first ever found in an *A. afarensis* fossil—is still locked in sandstone. But if it shows that *A. afarensis* babies lacked opposable big toes, their mothers might have had to rely on others for food and protection while tending their babies.

FROM THE WAIST DOWN THE DIKIKA BABY LOOKED LIKE US

teeth and unerupted adult teeth. All of her tiny ribs were positioned, as in life, along a sinuous spinal column. One finger was still curled in a tiny grasp, and where her throat once was, Zeresenay found a rare example of a hyoid bone, a bone that later became crucial to human speech. The discovery offers an early glimpse of the evolution of the human voice box, says Fred Spoor of University College London, another member of the study team.

From the waist down the Dikika baby looked like us. One of her humanlike knees was complete with a kneecap no bigger than a dried pea. But her upper body, like Lucy's, had many apelike features. Her brain was small, her nose flat like a chimpanzee's, and her face long and projecting. Her finger bones were curved and almost as long as a chimp's. Her two complete shoulder blades, the first ever found from an australopith, were similar to those of a young gorilla—a shape that might have made it easy for her to climb. *A. afarensis* walked on two feet, but some scientists think this species also spent time in trees.

Either way, the Dikika baby was a distinctly different creature from the apes that her ancestors had diverged from several million years earlier. The differences rippled through later human evolution, affecting everything from family ties to the origin of speech.

As apelike feet evolved to support and propel an upright body, they could no longer grasp objects with a thumb-like big toe, as the feet of chimps and other apes can. For hominin mothers and infants, the consequences were momentous: While chimp babies cling to their mothers' hair with muscular hands and grasping toes, a baby hominin probably had to be carried, limiting the mother's ability to provide for herself. She may have had to depend on her mate and the larger group—which may have strengthened social bonds and could help explain why humans are largely monogamous, unlike most apes. Brain evolution expert Dean Falk speculates that the helplessness of baby hominins could even lie at the root of speech, which could have evolved from "motherese," the sounds a mother makes to comfort her baby when she has to set it down.

The Dikika fossil also hints that brain development may already have started to take longer, a change that prolonged the dependence of human young on their parents. From the Dikika baby's teeth, the team estimated her age at three

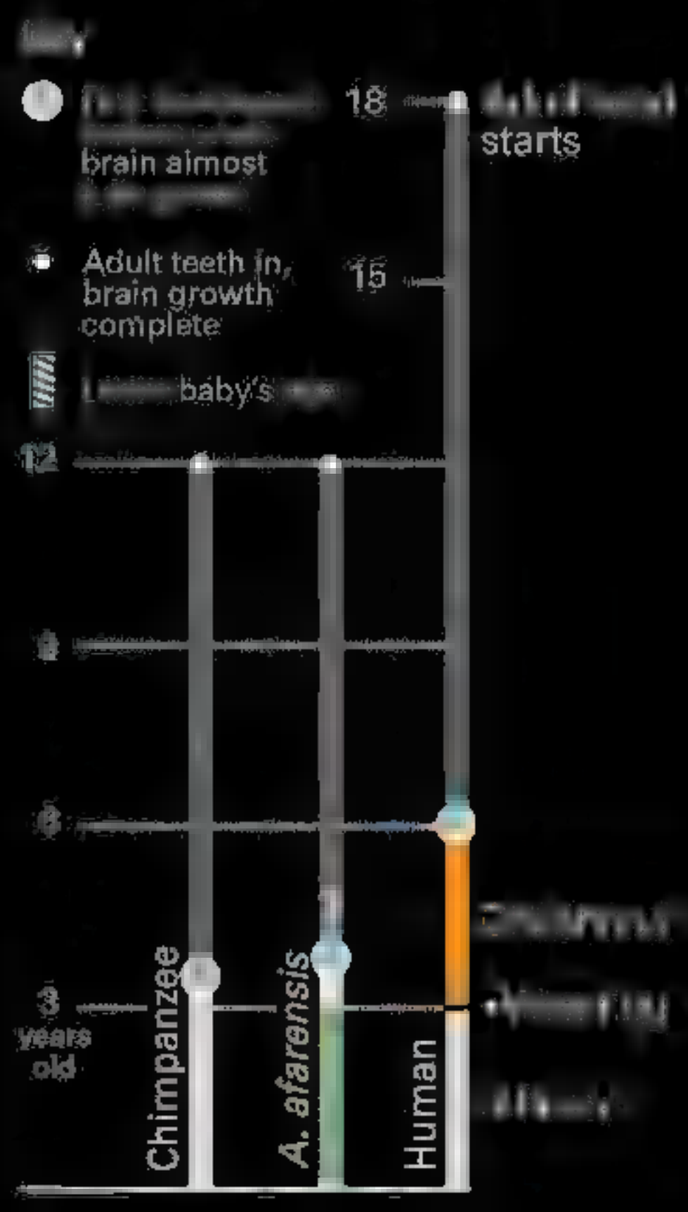
Sandstone
cast of brain

Unerupted
molar

Milk teeth

Dikika baby
Age: 3
Brain volume:
(cubic centimeters)

A Human Brain



CT IMAGE: ZERESENAY ALEMSEGED
SPOOR. BAR GRAPH: NGM ART.
BOGIN, B. H., 1996

years; her brain, preserved as a sandstone cast inside the skull, had a volume of about 330 cubic centimeters—roughly the same as a small three-year-old chimpanzee's. This could mean her brain was growing no faster than a chimp's; Zeresenay believes it might have taken longer to reach its adult size, slightly larger in an australopith than in a chimp.

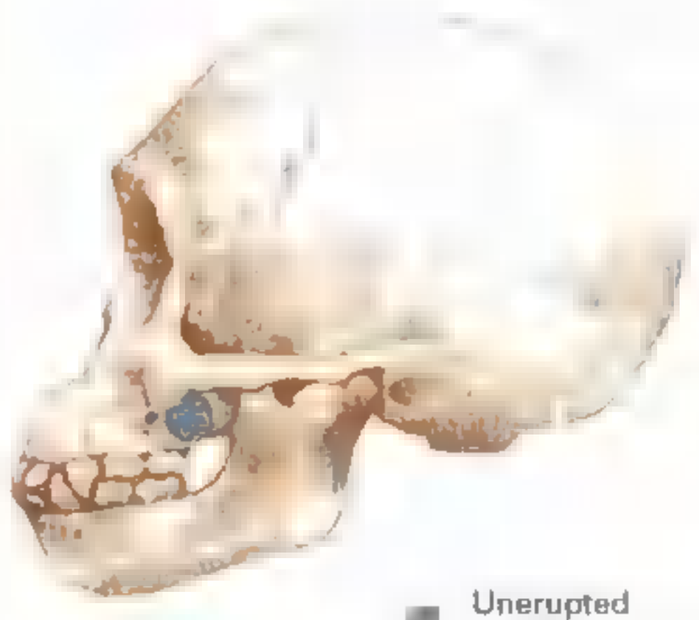
In most mammals, including other primates, the young move on to forage for themselves after they finish nursing. But during human evolution, ever longer brain growth led to the extended period of dependence we call childhood. In the Dikika baby, Zeresenay already sees hints that this uniquely human life stage was starting. "This is extraordinary," he says. "We've captured a moment in time for an individual, but also a moment in the life history of a species."

A cascade of other changes may have begun around that time. "It's no good growing a big brain if you don't have a long life span," says Holly Smith, an expert on hominin development at the University of Michigan. "You need that for the investment in a big brain to pay a return." She sees the emergence of childhood as a sign that human ancestors were also living longer than their ape cousins, a trend that ultimately led to humans outliving other apes by decades.

Growing bigger brains had other consequences. Gray matter is the gas-hog of our bodies. A fifth of the calories we consume go to fuel our brain. Within a million years of the Dikika baby our ancestors learned to supplement the mostly vegetarian diet of Lucy and her kin with nutrient-packed meat, devising stone tools to strip flesh and crack bones for the protein-rich marrow. Good nutrition made even bigger brains possible. And that led to more inventions, and then bigger brains. The rest is history.

The Dikika baby's biography is short, but the evolutionary steps she embodied have had profound and enduring effects. Although bipedalism and big brains carried a high cost, particularly for the mothers of our lineage, these traits ultimately combined to produce smarter babies who would eventually be able to master technologies, build civilizations, and, yes, explore their own origins. □

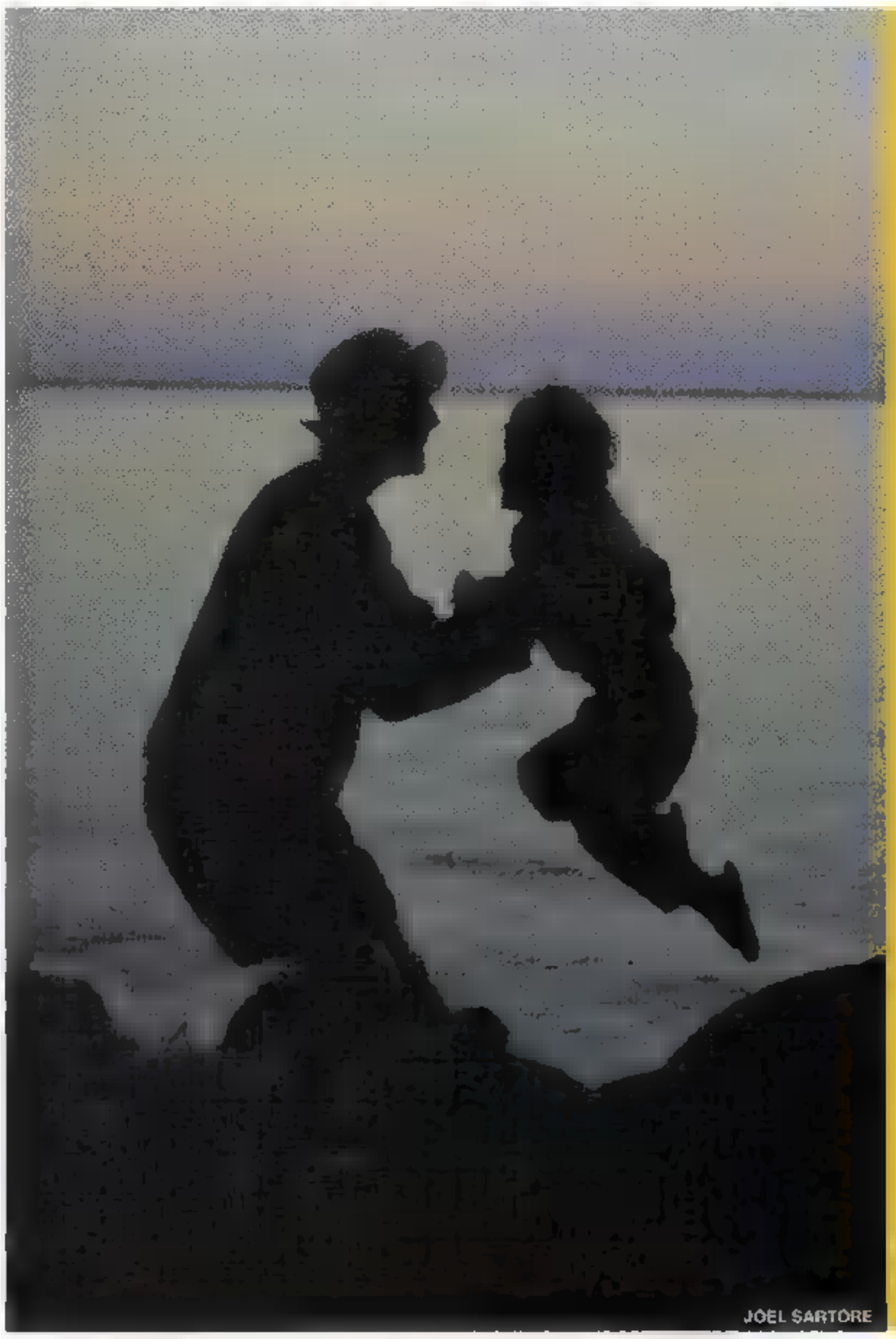
A CT scan of the Dikika baby's skull (left) offers a snapshot of *A. afarensis* life history, showing her tooth development and the size of her brain. Her first permanent molars had not yet erupted, indicating an age of about three; her brain volume was 330 cc—in the same range as a three-year-old chimp's and far smaller than a human's at the same tooth stage (below). Yet her adult brain would have been slightly larger than a chimp's, suggesting that brain growth in *A. afarensis* was already starting to take longer (chart, lower left)—the faint beginnings of human childhood.



Chimpanzee
Age: 3
Brain volume: 330-380 cc

Human
Age: 5
Brain volume: 1050-1150 cc

Roots of family life Follow an evolutionary time line back 3.5 million years and manipulate a 3-D version of the Dikika baby at **ngm.com/0611**.



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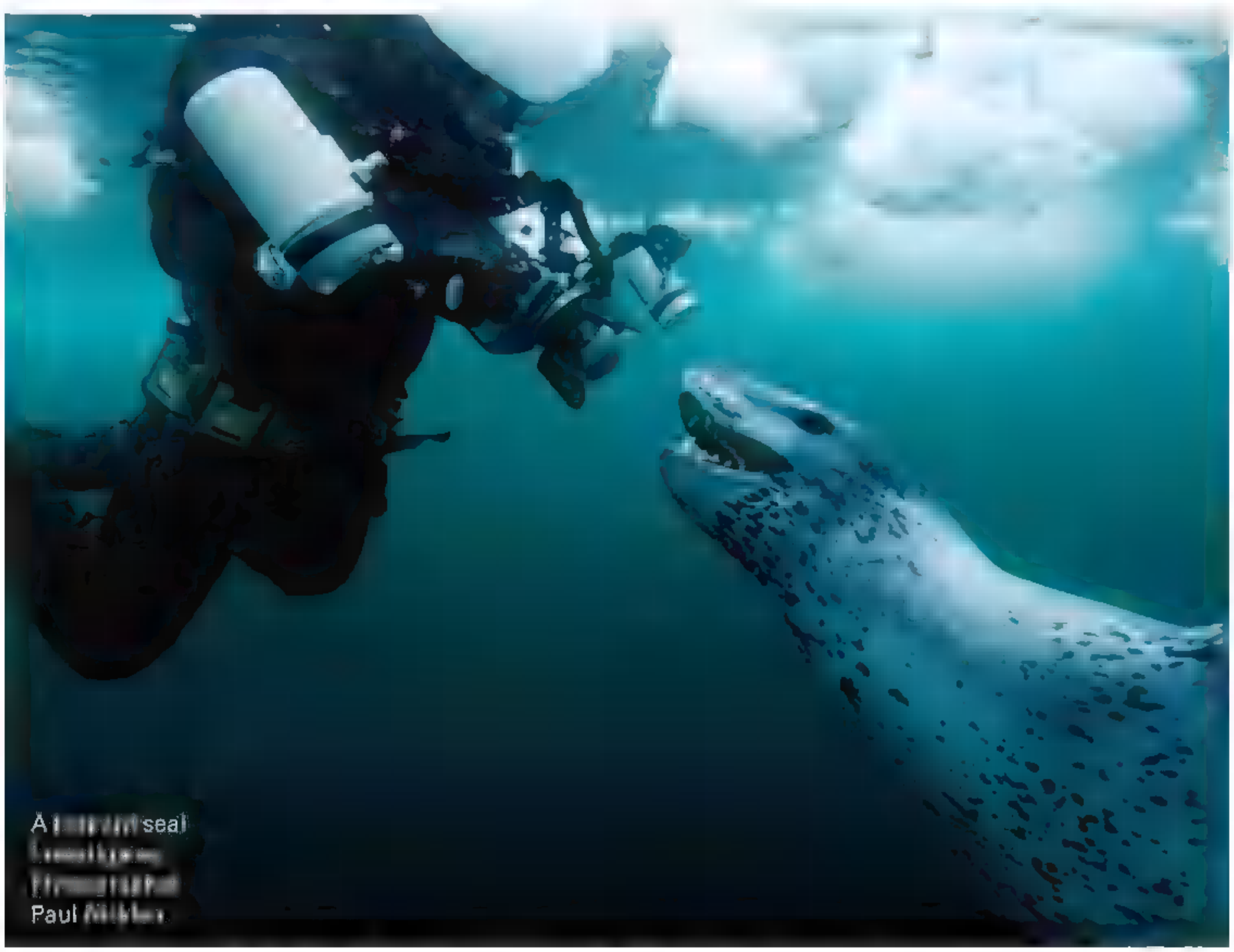

ON ASSIGNMENT **His Seal of Approval** "I was trembling, and my mouth was dry. I could hardly get my flippers on," says Paul Nicklen of preparing for his first swim with leopard seals—animals with a fierce reputation. Within minutes of getting in the water, though, the photographer's worries disappeared. One 12-foot-long female approached and offered Nicklen what he deemed a token of her esteem: a penguin. "We built this bond right away," he says. He saw her for several days during the shoot; she even chased away other seals, stole their penguins, and offered them to him. "It was the most wonderful animal by far that I've ever photographed," Nicklen says. "I will never forget her."

My Wonderful World.org

BEHIND THE SCENES **Where's Nauru?** Despite daily news coverage of Iraq, six in ten young adults ages 18 to 24 can't find that country on a map. Seventy-five percent of them can't find Indonesia, major site of damage from the 2004 tsunami. National Geographic, along with partners including 4-H, Sesame Workshop, and the National PTA, hope to improve geographic literacy with My Wonderful World—a five-year call to action for children, parents, and schools. November 12-18 is Geography Awareness Week: Go to *mywonderfulworld.org* now to test your global IQ and discover ways to bring geography into the home and classroom. You might just learn that Nauru is an island nation in the western Pacific, and the world's smallest independent republic.

PHOTO: GÖRAN EHLMÉ

If You Own a Home or Building with Corrugated Stainless Steel Tubing Used for Gas Transmission Installed as of September 5, 2006,

You May Have a Claim in a Proposed Class Action Settlement.

There is a Proposed Settlement of a class action lawsuit concerning certain corrugated stainless steel tubing ("CSST") used for the transmission of fuel gas into residential, commercial and industrial structures. The class action, *Lovelis, et al. v. Titeflex Corp., et al.*, CIV. No. 04-211, is pending in the Circuit Court of Clark County, Arkansas.

What is CSST?

CSST is corrugated stainless steel tubing used to transmit fuel gas in residential, commercial and industrial structures. CSST consists of a continuous, flexible, stainless steel pipe, and typically is covered with a yellow exterior plastic coating. CSST typically is routed beneath, through and alongside floor joists, inside interior wall cavities and on top of ceiling joists in attic space from a gas source to an appliance. CSST does not include gas-appliance connectors (*e.g.*, a connector that runs from a gas outlet to an appliance).

What is the Class Action About?

The lawsuit claims that CSST poses an unreasonable risk of fire due to lightning strikes. Plaintiffs allege that the CSST tubing is not thick enough to prevent damage to the CSST in the event of a lightning strike. Plaintiffs also allege that Defendants failed to warn consumers about the alleged dangers of CSST due to lightning strikes.

The Settling Defendants, Titeflex Corporation, Ward Manufacturing, Inc., OmegaFlex, Inc. and Parker Hannifin Corp. deny these allegations. These Defendants have decided to settle the claims to avoid the additional expense of litigation.

Who Is Involved?

The Settlement Class consists of any and all persons and/or entities who own structures in the United States in which CSST manufactured by Settling Defendants was installed as of September 5, 2006 ("Settlement Class Members").

What Does the Proposed Settlement Provide?

The Proposed Settlement provides Payment Vouchers for Settlement Class Members who qualify for relief. These Vouchers defray the costs of buying and installing a lightning protection system or bonding and grounding of certain systems in a structure.

Settlement Class Members who have CSST manufactured by Settling Defendants will be entitled to a Payment Voucher that can be used either toward the installation of a Lightning Protection System (including Bonding and Grounding) or for Bonding and Grounding of the systems in their property. Payment Voucher values range from $200 to $2,000 for the installation of a Lightning Protection System to $75 to $160 for Bonding and Grounding only.

Who Represents Me?

The Court has appointed attorneys to represent the Class. Class Counsel will request the Court award fair and reasonable attorneys' fees and costs.

No attorneys' fees will be deducted from the benefits paid to Settlement Class Members. You may hire your own attorney, if you wish. However, you will be responsible for that attorney's fees and expenses.

What Are Your Options?

You are automatically a Settlement Class Member if you own a structure with CSST manufactured by Settling Defendants that was installed as of September 5, 2006.

- If you do not want to be legally bound by the Proposed Settlement, you must exclude yourself in writing, postmarked by **January 8, 2007** and sent to the Settlement Administrator at the address below. Excluding yourself will allow you to bring your own claims against the Settling Defendants.
- If you stay in the Settlement Class you are entitled to file a claim. Your claim must be postmarked by **September 5, 2007** and sent to the Settlement Administrator at the address below. You may object to or comment on any aspect of the Proposed Settlement. Your objection/comment must be written and postmarked by **January 8, 2007** and filed with the Clark County Circuit Court, 401 Clay Street, Arkadelphia, AR 71923. You may also request in writing to speak at the Final Approval Hearing.

The detailed *Notice of Proposed Class Action Settlement* describes the procedures for excluding yourself, objecting or requesting to speak at the Hearing and can be obtained as outlined below.

Will the Court Approve the Proposed Settlement?

The Court will hold a Final Approval Hearing on February 1, 2007 at 1 p.m. CST and will consider whether to approve the Proposed Settlement, award attorneys' fees and allow reimbursement of expenses.

How Do I Obtain Further Information?

This is only a summary of the Proposed Settlement. For a more detailed *Notice of Proposed Class Action Settlement*, additional information on the Settlement, a copy of the Stipulation and Settlement, information identifying CSST or how to file a claim:

Call: 1-800-420-2916 Visit: www.csstsettlement.com

or Write: CSST Settlement Administrator, P.O. Box 4349, Portland, OR 97208-4349

INSIDE GEOGRAPHIC

Reinhold Messner and Caroline Alexander visit Antarctica's Elephant Island, where Ernest Shackleton launched the voyage to rescue his stranded crew.

ON ASSIGNMENT

Meeting Messner

It was Caroline Alexander's fascination with Ernest Shackleton—she wrote *The Endurance* about the polar explorer—that led to her story on Reinhold Messner in this issue. Booked to speak about Shackleton aboard an Antarctic cruise ship, she met Messner, a fellow lecturer. The pair spent hours discussing Messner himself: "We'd sit in the lounge, waves and icebergs outside, to have tea and cake, and talk about his life." Since the legendary mountaineer is usually too busy for such indulgences, Alexander says, "I sensed I'd been very lucky to spend time with a truly historic person."

November Contributors

Cathy Newman, a NATIONAL GEOGRAPHIC senior writer, interviewed the artists Christo and Jeanne-Claude for Voices (page 32).

Caroline Alexander wrote "Murdering the Impossible" (page 42) about the life of mountain climber Reinhold Messner. Alexander is a contributing writer for the GEOGRAPHIC.

Vincent J. Musi's photos illustrate the Messner article. His Photo Journal of Crawford, Texas, appeared in the GEOGRAPHIC's August 2006 issue.

Paul Nicklen swam with leopard seals to photograph "Deadly Beauty" (page 68).

Kim Heacox wrote the essay on leopard seals (page 72). His memoir, *The Only Kayak,* came out in paperback this year.

Mimi Swartz, an executive editor at *Texas Monthly,* is the author of "Once Upon a Time in Laredo" (page 92).

Penny De Los Santos grew up in Texas. Her photos for "Once Upon a Time in Laredo" are part of an ongoing project about South Texas.

Carl Zimmer is working on his sixth book, which concerns the *E. coli* bacterium and the meaning of life. He wrote "A Fin Is a Limb Is a Wing" (page 110).

Rosamond Purcell made the photographs for "A Fin Is a Limb Is a Wing." *Bookworm,* her latest book, was published in September.

Jennifer S. Holland is a GEOGRAPHIC senior writer. She covered the precarious existence of red-eyed tree frogs in "It's a Frog's Life" (page 136).

Christian Ziegler, a tropical ecologist turned photographer, captured the red-eyed tree frogs on film.

Christopher P. Sloan, the GEOGRAPHIC's senior editor for graphics, is author of "The Origin of Childhood" (page 148).

Kenneth Garrett photographed "The Origin of Childhood." His most recent story for the magazine was "The Judas Gospel" in May 2006.

Tales From the Field Learn more about our contributors in Features at **ngm.com/0611.**

PHOTO: GEORGE BUTLER, CONTACT PRESS IMAGES

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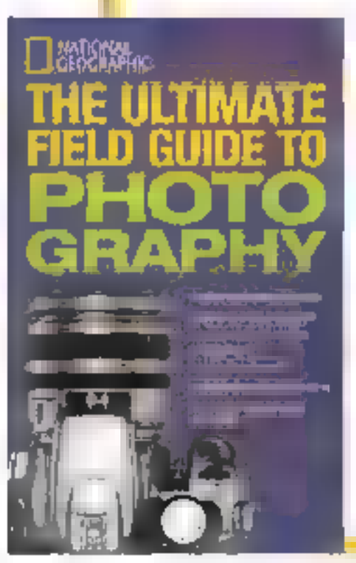
INSIDE GEOGRAPHIC

Representing their states in the National Geographic Bee: (clockwise from top left) Hannah Goodman, Montana; Autumn Hughes, Colorado; Devin Matthews, Arkansas; Kelsey Schilperoort, Arizona; Paige dePolo, Nevada; Caitlin Snaring, Washington; and Laura Kulm, Rhode Island.

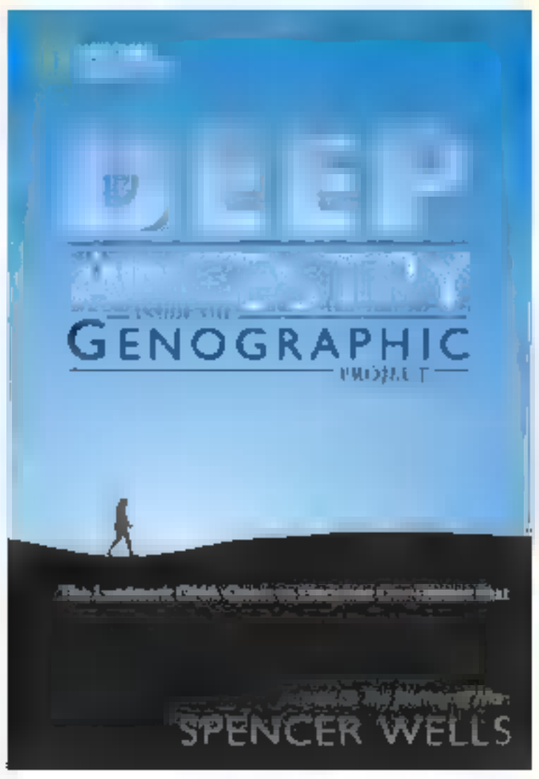
BEHIND THE SCENES Girl Power These young women keep busy playing the piano, swimming, dancing, participating in school bands. They also spend hours every day studying maps; a few have been known to correct their teachers about geography. One even notified a book publisher about an error in an atlas. They are their state's top geography whizzes, and they represent the largest number of females to make it to the National Geographic Bee in more than ten years. Caitlin Snaring explains her success: "Geography is way more fun than watching TV." Paige dePolo seconds the sentiment: "Mongols were so cool." Three girls—Paige, Kelsey Schilperoort, and Autumn Hughes—placed in the top ten, a Bee first. Although a girl did not take the top prize—Illinois eighth grader Bonny Jain won—a gift Kelsey gave to her peers said it all: a cookie cutter with a note, "Girls Can Cut It."

NG Books

The Ultimate Field Guide to Photography This comprehensive book features how-to information for using both film and digital cameras. It offers advice on image manipulation, printing, composition, and archiving, as well as ideas for projects to try at home. Browse professional photographers' portfolios, and discover their best tips and techniques ($24.95).



Deep Ancestry National Geographic Explorer-in-Residence Spencer Wells explains his Genographic Project with the help of stories and data from five different people around the world. Learn how the Genographic Project uncovers common human origins through the genetic backgrounds of a descendant of Thomas Jefferson, an Arizona Navajo, a Kallar man from southern India, a Tanzanian hunter-gatherer—and Wells's own grandmother ($24).



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FLASHBACK

X-ray Bouquet The ghost of a rose blooms in a radiograph by Albert G. Richards, professor emeritus at the University of Michigan School of Dentistry. He may have taught about teeth, but he thought about flowers, using dental equipment to x-ray his first, a daffodil, in 1960. Richards, now 89, went on to make more than 4,000 of the floral images over the next four decades. —*Margaret G. Zackowitz*

Flashback Archive Photos in Fun Stuff at **ngm.com/0611.**

IMAGE: ALBERT G. RICHARDS

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